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# Social Cognitive Predictors for Undergraduate College Student's Choice Goals in Math and Science: Understanding the Role of Coping Efficacy

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LOYOLA UNIVERSITY CHICAGO

SOCIAL COGNITIVE PREDICTORS FOR UNDERGRADUATE COLLEGE  
STUDENT'S CHOICE GOALS IN MATH AND SCIENCE: UNDERSTANDING  
THE ROLE OF COPING EFFICACY

A DISSERTATION SUBMITTED TO  
THE FACULTY OF THE GRADUATE SCHOOL  
IN CANDIDACY FOR THE DEGREE OF  
DOCTOR OF PHILOSOPHY

PROGRAM IN COUNSELING PSYCHOLOGY

BY

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CHICAGO, ILLINOIS

AUGUST 2012

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## ABSTRACT

This study examined the utility of Social Cognitive Career Theory (SCCT; Lent, Brown, & Hackett, 1994) in the prediction of undergraduate college student's math and science interests and choice goals. Coping efficacy and self-efficacy beliefs were assessed separately in order to better understand the relationships between supports, barriers, coping efficacy, and math/science self-efficacy within the SCCT model. Two-hundred and forty-six undergraduate college students completed measures of math and science-related supports, barriers, coping efficacy, self-efficacy, outcome expectations, interests, and choice goals. A model specifying that barriers, but not supports, were directly related to math and science choice goals provided the best fit to the data. Paths within the best-fitting model provided support for hypotheses specific to SCCT's interest and choice models. Findings also revealed that coping efficacy partially mediated the relation between supports and math/science self-efficacy. In addition, coping efficacy was found to serve as both a mediator and a moderator in the relationship between barriers and math/science self-efficacy beliefs. Implications for career counseling and for future research on the SCCT model are discussed.



## CHAPTER ONE

### INTRODUCTION

The contribution of STEM (science, technology, engineering, and mathematics) fields in shaping the economic future of America is well documented (Committee on Science, Engineering, and Public Policy, 2006). The economic success of America in STEM fields will greatly depend on the math and science-related skills of future generations. According to the Bureau of Labor Statistics (2011), by the year 2018, numerous careers with a reliance on science and mathematic skills are projected to grow in demand in the United States at a much faster rate of increase than the national average. This increase requires that the number of undergraduate students completing math/science coursework also needs to increase.

As the world-of-work becomes increasingly more technically advanced, all college students (regardless of whether they choose to pursue STEM careers or not) will need a stronger skill set in math and science to be successful. A lack of college preparation in math and science-related coursework may seriously hinder college graduates' ability to be competitive in today's challenging job market. Research is, therefore, needed on predictors of math and science academic performance to increase the probabilities that college undergraduates have the necessary skills to be successful in today's workforce. Social Cognitive Career Theory (SCCT; Lent, Brown, & Hackett, 1994) provides a possible framework to assist in answering this call and has been studied

extensively for its ability to explain and predict math and science and STEM career engagement.

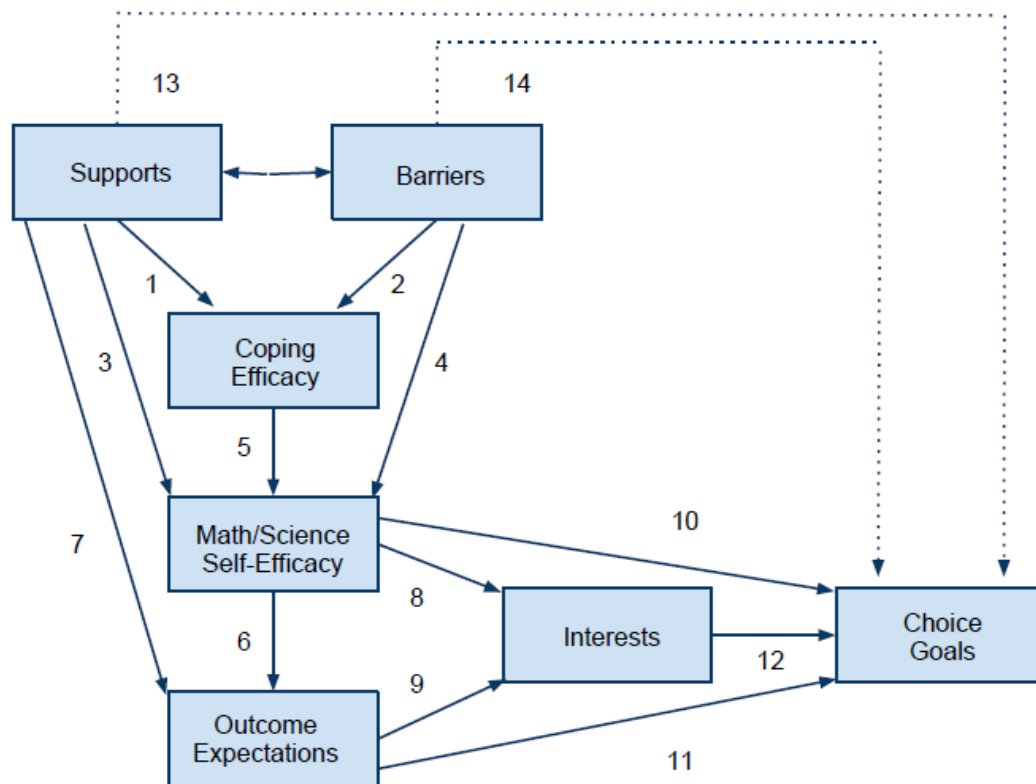
### **Social Cognitive Career Theory**

Social Cognitive Career Theory has generated substantial research in the area of career development. The theory expands the work of Bandura (1986) by applying social cognitive concepts to the areas of academic and career development. The SCCT model has been used in numerous studies to examine math/science interests and choice goals of college students (Byars-Winston & Fouad, 2008; Byars-Winston, Estrada, Howard, Davis, & Zalapa, 2010; Gainor & Lent, 1998; Lent et al., 2001; Quimby, Seyala, & Wolfson, 2007; Waller, 2006). The theory seeks to understand the interacting role of person, experiential, and contextual factors in the prediction of adolescent and early adulthood academic and career behaviors. Social Cognitive Career Theory provides models to explain and predict (a) the processes by which individuals form academic and career interests (Interest Model), (b) the development of choice intentions or goals (Choice Model), and (c) the attainment of performance outcomes (Performance Model). The current research will focus on the interest and choice models to explore factors that might give rise to math/science interests and intentions to enter math/science careers.

The study was designed, in part, as a replication of previous research that has tested SCCT's ability to predict interests and choice goals in STEM fields. The primary focus of the study, however, was unique. It sought to explore the potential role of coping efficacy as a heretofore understudied variable in research on SCCT. The model to be

tested in this study is displayed in Figure 1. The remaining pages of this introduction will first provide rationales and supporting data for the main paths suggested by prior research on SCCT. These are the paths which this study seeks to replicate. The introduction will then introduce coping efficacy beliefs and suggest several hypotheses about how such beliefs may relate to and interact with other SCCT variables to predict intentions to engage in math/science activities that are related to STEM careers. This chapter will conclude by summarizing the purposes of the study and the models and hypotheses that will be tested.

Figure 1. Proposed Relations to be Examined in the Current Study.



*Note.* The above model is a modified version of the Lent et al. (2001) SCCT model.

### **SCCT Interest Model**

According to SCCT's interest model, interest in a particular domain is jointly predicted by self-efficacy beliefs and outcome expectations. Therefore, interests in math/science activities are best predicted by peoples' beliefs in their abilities to successfully perform math/science-related tasks (math/science self-efficacy) along with a consideration of their expectations about the utility of engaging in math/science behavior (outcome expectations).

There is research support for the individual and combined utility of self-efficacy beliefs and outcome expectations in predicting interests in math and science-related activities. Quimby and colleagues (2007), for example, examined the math/science self-efficacy and outcome expectations of environmental science college students and found both to be significant predictors of their interest in environmental science. These results were consistent with other findings using general undergraduate student samples (Lent et al., 2001; Byars-Winston & Fouad 2008). Both studies found math/science self-efficacy beliefs and outcome expectations predicted math/science interests with effect sizes that were comparable to earlier (Lent et al., 1994) meta-analytic estimates (i.e., .53 for the self-efficacy-interest relationship and .52 for the outcome expectation-interest relationship).

Sheu et al. (2010) also found moderate meta-analytic path coefficients for the relation of both self-efficacy and outcome expectations to interests in activities for Holland's Investigative theme (activities related to math and science interests). The

relations of self-efficacy beliefs and outcome expectations to math/science interests seem to hold not only for general college student populations, but also for middle school (Fouad & Smith, 1996) students as well as African American college freshmen (Gainor & Lent, 1998). Fouad and Smith (1996) and Gainor and Lent (1998) found math/science self-efficacy beliefs and outcome expectations to be positively related to each other. This finding is consistent with SCCT hypotheses; that, believing that one can be successful will lead one also to expect more positive than negative outcomes from task involvement. Thus, this study hypothesizes that math/science self-efficacy beliefs and outcome expectations will both be positively related to math/science interests (paths 8 and 9 in Figure 1). It is also hypothesized that math/science self-efficacy beliefs will be positively related to outcome expectations (Path 6 in Figure 1).

### **SCCT Choice Model**

According to SCCT's choice model, individuals choose academic and career fields that are consistent with their self-efficacy beliefs, outcome expectations, and interests. The influence of self-efficacy beliefs and outcome expectations on choice intentions is largely (but not fully) mediated by interests (Lent et al., 1994). More specifically, strong self-efficacy beliefs and positive outcome expectations within a specific domain give rise to interests in that domain. These interests, in turn, result in a greater likelihood of pursuing that domain. In addition, SCCT hypothesizes that self-efficacy beliefs and outcome expectations can have direct (albeit smaller) effects on

choices intentions and may become particularly important when interests need to be compromised in favor of other influences (e.g., family) in the choice making process.

A review of the SCCT literature reveals numerous studies showing that the relations of self-efficacy beliefs to choice goals is partially mediated by interests and that interests have significant direct relations with choice goals (c.f. Lent et al., 2001; Byars-Winston & Fouad, 2008). For instance, Sheu et al. (2010) in their meta-analytic investigation found a moderate standardized path coefficient (.35) between interests in fields classified as Investigative and choice goals to enter these types of fields. Other studies have found that the influence of self-efficacy on choice goals is also direct, especially in STEM fields (Byars-Winston & Fouad, 2008; Lent, Brown, Schmidt, et al., 2003; Lent et al., 2005; Lent et al., 2011; Waller, 2006). In particular, meta-analytic findings by Sheu et al. (2010) found that the direct relation of self-efficacy to choice goals in math and science domains was, as hypothesized by SCCT, smaller than those between interests and choice goals.

Interests also seem to mediate the relation between outcome expectations and choice goals in STEM fields (Lent et al., 2011; Waller, 2006), but the direct relation of outcome expectations to choice goals is less conclusive in SCCT studies involving the STEM fields. However, several studies (e.g., Byars-Winston & Fouad, 2008; Lent et al., 2001) have reported significant direct relations between outcome expectations and choice goals. Byars-Winston and Fouad (2008) and Lent et al. (2001), for example, specifically examined the SCCT model using math and science social cognitive variables and found

significant moderate relations between outcome expectations and choice goals. Sheu et al. (2010) in their meta-analytic investigation of SCCT across Holland themes also found a moderate and significant path between outcome expectations and choice goals classified within the Investigative theme. Thus, the current study will include a direct path between self-efficacy beliefs and outcome expectations to choice goals as well as mediated paths through interests to be consistent with previous findings. In other words, it is hypothesized that self-efficacy beliefs will relate to interests (path 8 in Figure 1) and choice goals (path 10 in Figure 1), but that the path to interests will be larger than the path to choice goals. Similarly, it is hypothesized that outcome expectations will relate to interests (path 9 in Figure 1) and choice goals (path 11 in Figure 1), but that path 11 will be smaller than path 9. Finally, it is hypothesized that interests will also relate to choice goals (path 12 in Figure 1).

In summary, SCCT hypothesizes that self-efficacy beliefs serve as a source of outcome expectations (i.e., they are positively related). In addition, SCCT hypothesizes that self-efficacy and outcome expectations jointly promote interests in specific domains and that the effects of these two social cognitive variables on choice goals are mediated by interests. Finally, SCCT hypothesizes that the mediating effects are partial (i.e., self-efficacy beliefs and outcome expectations have direct paths to choice goals).

### **Contextual Influences**

In addition to the influence of social cognitive person variables on interests and choice intentions, SCCT also hypothesizes that certain contextual variables will influence

college students' levels of interest in math/science activities and their intentions to engage in STEM fields. Contextual influences can be understood as the social-environmental (e.g., socio-economic status, culture) that either enhance (e.g., role models/mentors) or impede (e.g., negative social/family influences) the academic and career choice process (Lent et al., 2002). Enhancing social-environmental factors are recognized as supports, while impeding social-environmental factors are viewed as barriers (Lent et al., 1994). These supports and barriers combine to form the contextual influences that impact the academic and career process.

Lent, Brown, and Hackett (2000) suggested that future SCCT studies assess contextual influences in relation to specific choice options. Since this declaration, numerous SCCT studies examining the impact of contextual influences on domain-specific choices have followed (Byars-Winston & Fouad, 2008, Fouad et al., 2010; Lent et al., 2001, Lent, Brown, Schmidt, et al., 2003; Lent et al., 2005; Lent et al., 2011; Quimby et al., 2007). Some of this research has focused on the different contextual influences specific to women (Fouad et al., 2010; Lent et al., 2005), ethnic minorities (Quimby et al., 2007), or different types of university (e.g., Historically Black universities; Lent et al., 2005). Across these studies supports and barriers have been found to relate to interests in and intentions to pursue STEM fields.

Students of various ages, ethnicities, and genders encounter substantial barriers in their academic and career pursuits (Albert & Luzzo, 1999; Flores & O'Brien, 2002; Luzzo, 1996; McWhirter, 1997; Quimby & O'Brien, 2004; Swanson, Daniels, & Tokar,



1996) and research has confirmed expectations that barriers are related negatively to the pursuit of a number of different career fields, especially the STEM field (e.g., Fouad et al., 2010). Fouad et al. (2010) examined barriers and supports specifically related to the pursuit of coursework or careers in the math and science and concluded that the presence of just a few barriers in these particular domains may be sufficient to cause students to elect out of taking math and science-related courses and pursuing STEM careers. While the relation between barriers to academic or career choice is well documented in the career development research, supports have not traditionally received the same empirical attention. More focus on the inclusion of supports in studies with college students could provide added information on how to promote the academic and career pursuit of STEM fields.

Fouad et al. (2010) in their assessment of barriers and supports specific to pursuing math and science coursework and careers found significant negative correlations between both math barriers and math supports as well as between science barriers and science supports. Previous SCCT studies examining the pursuit of STEM fields have also found significant negative correlations between supports and barriers (Lent et al., 2001; Lent, Brown, Schmidt, et al., 2003; Lent et al., 2005, Lent et al., 2011). These findings are in line with meta-analytic findings across Holland themes, particularly the Investigative theme ( $r = -.20$  for the relationship between supports and barriers; Sheu et al., 2010). Thus, supports and barriers will be allowed to correlate (see Figure 1) in the models examined in this study.

SCCT (Lent et al., 1994) originally hypothesized that barriers and supports influence the choice-making process (e.g., ability to establish choice intentions), in part, via their direct influences on choice intentions. In other words, SCCT hypothesized that barriers would show a direct negative relation to choice goals (path 14 in Figure 1), while supports would relate positively to choice intentions (path 13 in Figure 1). Stated more simply, people are more likely to develop intentions to pursue a specific academic or career options if they perceive few barriers and ample support for this option. Subsequent research, however, has not supported these hypotheses. Rather, the data seem to indicate that the influence of barriers and supports on choice intentions is largely (if not fully) mediated by self-efficacy beliefs and perhaps also outcome expectations. Thus, rather than influencing intentions directly, the research suggests that supports facilitate the acquisition of self-efficacy beliefs and outcome expectations in specific career areas (e.g., STEM careers), while barriers hinder the acquisition of career-related self-efficacy beliefs and outcome expectations. The latter (self-efficacy beliefs and outcome expectations) then influence the types of interests that people develop and (in part) their intentions to pursue interest-congruent occupations.

For example, Lent et al. (2001) and Lent, Brown, Nota, et al. (2003) tested the original SCCT model against a revised model that specified an additional indirect path through self-efficacy beliefs. Both studies found that the alternative model fit the data better than did the original model—that the relation of barriers and supports to choice intentions was largely mediated by self-efficacy beliefs. These empirical findings are

more consistent with Bandura's (1997) assertion that contextual influences affect choice goals both directly (e.g., experiencing discrimination during an interview) as well as indirectly via self-efficacy beliefs than with the original SCCT model. As a result of these findings, this study will include a direct path from supports and barriers to math/science self-efficacy beliefs. Thus, it is hypothesized that supports will be positively related to math-self efficacy beliefs (path 3 in Figure 1) and barriers will be negatively related to math-self efficacy beliefs (path 4 in Figure 1).

A recent meta-analytic investigation across Holland themes found that the relation of supports to choice goals was also mediated by outcome expectations. A direct and moderate relation between supports and outcome expectations was found in this study (standardized path coefficient = .23; Sheu et al., 2010). This finding suggests that supports may be particularly helpful in the promotion of outcome expectations. Consequently, this study will also include a direct path from supports to outcome expectations hypothesizing that supports will be positively related to outcome expectations (path 7 in Figure 1). A direct path from barriers to outcome expectations was not included in this study due to inconclusive findings in the literature that such a path exists.

Finally, a recent study by Byars-Winston and Fouad (2008) revealed that the relation between barriers and the math/science choice goals of undergraduate students was mediated through coping efficacy beliefs, not self-efficacy beliefs. Coping efficacy can be defined as one's belief in his/her ability to successfully manage impeding

contextual influences (Lent, Brown, & Hackett, 2000). This finding suggests that coping efficacy beliefs may deserve further examination within the SCCT interest and choice models.

### **Coping Efficacy**

Lent et al. (2000) suggested that coping efficacy and task self-efficacy are theoretically distinct, but related constructs. While task self-efficacy is reflective of the confidence needed to successfully complete a task, coping efficacy is representative of the confidence needed to manage situational features complicating that task. Lent et al. (2000) proposed that coping efficacy could mediate the influence of perceived barriers on choice goals or could potentially moderate the influence as well. The role of coping efficacy in the SCCT model has, however, yet to be tested. Thus, several hypotheses were developed, based on the literature reviewed next, about the role of coping efficacy beliefs in the development of math/science self-efficacy beliefs. These hypotheses, because they have yet to be tested, represent the main focuses of the current research.

Studies by Lent and colleagues (2001; Lent, Brown, Schmidt, et al., 2003; Lent et al., 2005; Lent et al., 2011) have revealed that robust efficacy beliefs mediate the relation of perceived supports and barriers to interests in the STEM fields. However, task and coping efficacy were combined to represent a single latent variable of self-efficacy beliefs in these studies. Research findings of a moderate correlation between measures of task and coping efficacy suggest that these variables should be measured separately in SCCT investigations. For example, Byars-Winston and Fouad (2008) reported a

correlation of .42 and Lopez and Yi (2006) found a correlation of .43 between coping efficacy scores and task self-efficacy scores, suggesting that these two constructs, while related, represent separate constructs. Lent et al. (2000) also suggested that coping and task self-efficacy should be measured separately in future studies on the SCCT interest and choice models. Thus, the current study will measure coping efficacy and math/science self-efficacy and explore their relations to other variables in the SCCT interest and choice models separately.

Several investigators (e.g., Byars-Wisnton & Fouad, 2008; Lent et al., 2000; McWhirter, Hackett, & Bandalos, 1998) have suggested that the major influence of coping efficacy in the SCCT model would be to mediate the relations between the experience of barriers and supports to self-efficacy beliefs. In other words, these hypotheses suggest that the experience of barriers can function to reduce persons' coping efficacy which, in turn, can result in reduced beliefs in task or domain self-efficacy. The experience of supports would be expected to have the opposite effect—to increase persons coping efficacy and in turn result in stronger math/science self-efficacy beliefs. However, the exact nature of these expected mediation effects have yet to be fully specified. As a result, the current study will examine coping efficacy's potential mediating role on the relations of supports and barriers to math/science self-efficacy beliefs. More specifically, the current study will include a direct path between supports and barriers to math/self-efficacy as well as mediated paths through coping efficacy. In other words, it is hypothesized that supports will relate to coping efficacy (path 1 in

Figure 1) and math/science self-efficacy (path 3 in Figure 1), but that the path to coping efficacy will be larger than the path to math/science self-efficacy. Similarly, it is hypothesized that barriers will relate to coping efficacy (path 2 in Figure 1) and math/science self-efficacy (path 4 in Figure 1), but that the path to coping efficacy will be larger than the path to math/science self-efficacy. Finally, it is hypothesized that coping efficacy will also relate to math/science self-efficacy (path 5 in Figure 1). These hypotheses represent the main as well as the last of the individual hypotheses that will be tested in the SCCT model presented in Figure 1. However, before testing these hypotheses, four different SCCT models pertaining to the direct relations of contextual influences on choice goals will be estimated and compared to ascertain their fit to the data. The model which best fits the data will be used to test the above outlined hypotheses.

### **Potential SCCT Path Models**

As previously stated, SCCT investigations examining the development of interests and choices in the STEM fields (Byars-Winston & Fouad, 2008; Lent et al., 2001; Lent, Brown, Nota, and Soresi, 2003; Lent, Brown, Schmidt, et al., 2003; Lent et al., 2011) have found mixed evidence for SCCT's original hypothesis that contextual influences have a direct relationship with choice goals. In other words, the research is unclear on whether or not supports and barriers directly impact the choice-making process. While some investigations have found neither supports nor barriers to have a direct relation to choice goals (Lent et al., 2001), others have found both supports and

barriers to have a direct relation to choice goals (Lent et al., 2011). Finally, other investigations (Lent et al., 2005) have found supports to have a direct relation to choice goals but have found no significant relation between barriers and choice goals. As a result of these inconsistent findings, the above outlined hypotheses will be assessed within one of four potential models. The first model will be a full mediation model and hypothesize that neither supports nor barriers have a direct relation to choice goals (i.e., paths 13 and 14 in Figure 1 will be fixed to 0). The second model (a partial mediation model involving barriers) will hypothesize that supports do not have a direct relation to choice goals (i.e., path 13 will be fixed to 0) but that barriers do have a direct relation to choice goals (i.e., path 14 will be freely estimated). The third model (a partial mediation model involving supports) will hypothesize that supports have a direct relation to choice goals (i.e., path 13 will be freely estimated) but that barriers do not have a direct relation to choice goals (i.e., path 14 will be fixed to 0). Lastly, the fourth model (a partial mediation model for both supports and barriers) will hypothesize that both supports and barriers have a direct relation to choice goals (paths 13 and 14 will be freely estimated).

### **Coping Efficacy as a Moderator**

Bandura (1997) has suggested an alternative way for coping efficacy beliefs to operate; namely, that the effects of barriers on other types of self-efficacy beliefs (e.g., math/science self-efficacy) may be different for those who display low versus high coping efficacy. This suggests that coping efficacy may have a moderating rather than mediating role in the relation between perceived barriers and self-efficacy beliefs. A

moderator effect would suggest that the relationship between barriers and task (i.e., math/science) self-efficacy beliefs would be lower under conditions of high versus low coping efficacy; that coping efficacy buffers persons from the negative influence of barriers on self-efficacy beliefs. This assertion was echoed by Hackett and Byars (1996) who proposed that African American women possessing high coping efficacy beliefs could experience successful performances despite expectations of encountering racism or discrimination in their academic or career pursuits. As a result of these proposals, an alternative hypothesis was also tested in this study. This hypothesis is that coping efficacy serves as a moderator in the relation between perceived barriers and math/science self-efficacy beliefs. The potential moderating role of coping efficacy on the relation between supports and math/self-efficacy was not examined due to a lack of previous literature suggesting that such a relationship exists.

### **Research Question and Hypotheses**

The main purpose of the study was to test two plausible hypotheses about the role of coping efficacy in the development of math/science self-efficacy beliefs. The first hypothesis suggested that the effects of coping efficacy beliefs are largely mediational (i.e., that coping efficacy will mediate the relation between supports and barriers to math/science self-efficacy; see Figure 1). Prior to testing this hypothesis, four SCCT models suggested by existing research were estimated and compared to ascertain their fit to the data. The mediation hypothesis for coping efficacy was tested within the model that best fit the data.



One model (Model A) hypothesized that the effects of supports and barriers on choice goals is fully mediated by coping efficacy, math/science self-efficacy, math/science outcome expectations, and math/science interests. This model was created by fixing paths 13 and 14 in Figure 1 (representing direct effects for supports and barriers on choice goals) to zero, while freeing the other paths. The other three models represented different partial mediation possibilities. One of these alternative models (Model B) hypothesized that the effects of supports on choice goals is fully mediated, while the effects of barriers is partially mediated (i.e., there is also a direct effect of barriers on goals). This model was created by modifying Model A and freeing the path from barriers to goals (path 14 in Figure 1) to be estimated. The next partial mediation model (Model C) hypothesized that the effects of supports rather than barriers on goals is partially mediated. This model was created by freeing the path from supports to goals in Model A to be estimated (path 13 in Figure 1), while leaving the path from barriers to goals (path 14 in Figure 1) fixed at zero. Finally, Model D hypothesized that the effects of supports and barriers on goals are both partially mediated. Thus, paths 13 and 14 in Model A were freed to be estimated.

An alternative to the mediational hypothesis about the interrelationships among barriers, coping efficacy, and math/science self-efficacy beliefs was also tested. This hypothesis suggested that coping efficacy may function more as a moderator of the barriers to math/science self-efficacy relationship (i.e., that coping efficacy might buffer the negative effects of barriers on math/science self-efficacy beliefs). This hypothesis

would be supported by finding that the negative relationship between barriers and self-efficacy beliefs is weaker when coping efficacy is high than when it is low.

## CHAPTER TWO

### LITERATURE REVIEW

The purpose of this chapter is to provide a review of the literature as well as present a framework for understanding the research conducted in this study. There are three main goals that will guide this chapter. The first goal is to provide a description of the full Social Cognitive Career Theory (SCCT; Lent et al., 1994) model. The second goal is to provide a summary and evaluation of the existing research relevant to the full SCCT model. Finally, the last goal is to clarify the role of this research study within the context of existing research on the SCCT model. The full SCCT model as it pertains to four main components of SCCT will be examined and evaluated: the interest model, choice model, performance model, and the role of contextual influences. Within each component of the SCCT model, research and literature specific to particular constructs will be discussed.

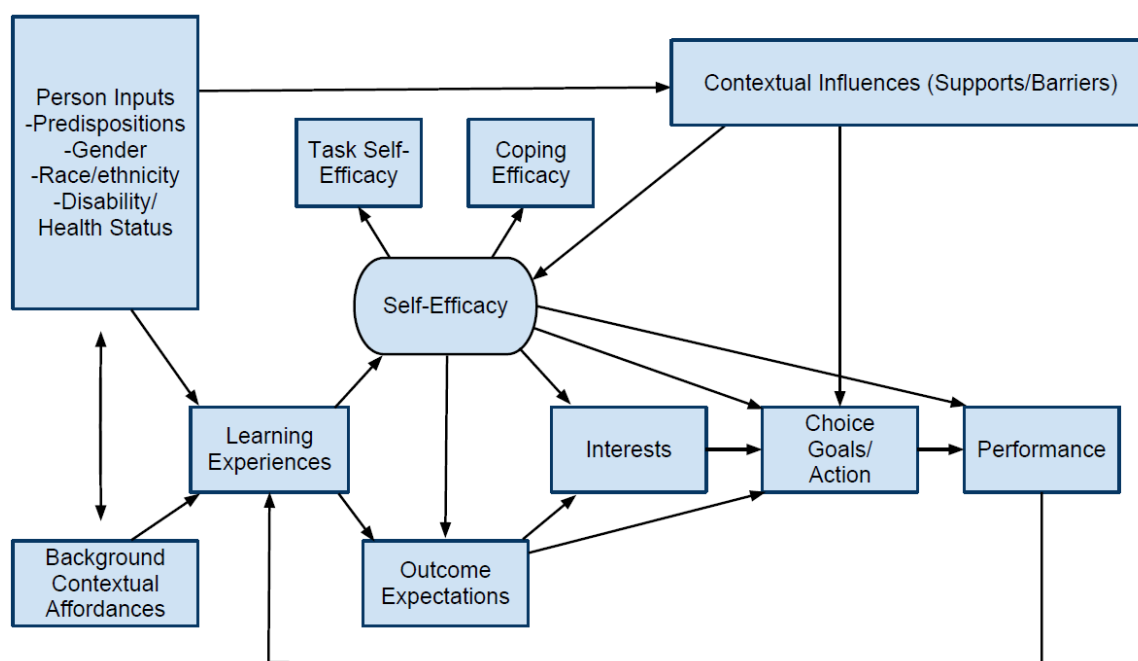
#### **Social Cognitive Career Theory**

Social Cognitive Career Theory examines the role of person, contextual, and behavioral factors in the development of academic and career relevant interests, choice goals, and performance (Lent et al., 1994). Based on Bandura's (1986) Social Cognitive Theory, SCCT emphasizes the relation of self-efficacy and outcome expectations on numerous career-related variables. These variables include person inputs, contextual

affordances and influences, learning experiences, interests, choice goals, and performance.

As outlined in Figure 2, SCCT posits that person inputs (e.g., gender) and background contextual affordances (e.g., gender role socialization) contribute to self-

Figure 2. Current Full SCCT Model.



*Note.* The above SCCT model is adapted from models depicted in Lent et al. (1994; 2001; 2003)

efficacy beliefs and outcome expectations by influencing relevant learning experiences (i.e., personal performance accomplishments, vicarious learning, social persuasion, and physiological states). Self-efficacy beliefs (i.e., task self-efficacy and coping efficacy) and outcome expectations contribute to the formation of academic and career-related interests, which subsequently influence relevant choice goals and performance. The

SCCT model also posits that one's interests, choices, and performance (either directly, indirectly, or both) are impacted by their environment throughout the academic and career development process (Lent et al., 2000).

### **SCCT Interest Model**

SCCT's interest model asserts that interests in a particular domain are predicted by self-efficacy beliefs and outcome expectations (Lent et al., 1994). Self-efficacy is the belief in one's ability to execute a course of action (i.e., “Can I do it”), while outcome expectations are beliefs about the consequences of particular courses of action (i.e., “What will happen if I do it”). According to Bandura (1997) and Lent et al. (1994), self-efficacy beliefs serve as a source of outcome expectations. That is, individuals tend to perceive positive outcomes in domains in which they feel efficacious in performing. Previous SCCT studies (e.g., Lent et al. 2001; Lent et al., 2011) have examined self-efficacy as a latent construct with task self-efficacy and coping efficacy serving as indicators. Within these studies, task self-efficacy is recognized as one's confidence to succeed in a specific domain (e.g., mathematics) when performance is not complicated by external factors (Bandura, 1997; Lent et al., 2000). Conversely, coping efficacy is recognized as one's confidence to succeed when performance is complicated by external factors.

According to SCCT (Lent et al., 1994) and Bandura (1986), prior learning experiences influence the formation of self-efficacy beliefs and outcome expectations. That is, positive prior learning experiences within specific domains increase the

likelihood of developing robust self-efficacy beliefs and positive outcome expectations in that domain. Learning experiences influence self-efficacy beliefs and outcome expectations through four main sources: past performance accomplishments (e.g., previously earning a high score on a math test), vicarious learning (e.g., observing someone similar to you succeed in a math course), social persuasion (e.g., being told by a teacher that you should consider advanced math subjects), and physiological states (e.g., interpreting anxiety during a math test as excitement to complete the test). Original SCCT hypotheses (Lent et al., 1994) purport that past performance accomplishments account for more variance in self-efficacy and outcome expectations than vicarious learning, verbal persuasion, and physiological states.

Learning experiences are influenced by person inputs and background contextual affordances. Person inputs are conceptualized as variables of individual differences and include constructs such as race, ethnicity, gender, and inherited traits. Background contextual affordances consist of the opportunities that were available during an individual's prior experiences. Therefore, background contextual affordances include things such as experience with and exposure to role models, familial support for the pursuit of particular activities, and gender role socialization processes (Lent et al., 1994).

In summary, interest in a particular domain is jointly predicted by one's self-efficacy beliefs and outcome expectations. Self-efficacy beliefs and outcome expectations are developed through prior learning experiences. For instance, positive learning experiences (e.g., previously earning a high mark in a math course) are likely to

result in greater confidence to succeed within a certain domain (e.g., math) as well as more positive expectations for future behavior within that domain. Lastly, learning experiences are directly influenced by person inputs and background contextual affordances.

### **SCCT Choice Model**

According to SCCT's choice model (Lent et al., 1994), individuals choose academic and career fields that are consistent with their self-efficacy beliefs, outcome expectations, and interests. In other words, choice goals are predicted by self-efficacy beliefs, outcome expectations, and interests. The influence of self-efficacy beliefs and outcome expectations on choice goals is largely mediated by interests (Lent et al., 1994). More specifically, strong self-efficacy beliefs and positive outcome expectations within a specific domain give rise to interests in that domain. These interests, in turn, are likely to result in choice goals which specifically relate to that domain.

Goals can be recognized in SCCT as both the intention to pursue a particular choice as well as the development of specific actions to implement that choice. For instance, the selection of a major such as engineering will lead to the establishment of specific goals to obtain the engineering major (e.g., enrollment in an engineering program). Once the pursuit of that major begins, performance goals may also be established to ensure the fulfillment of the goal. Choice intentions or goals established before the onset of choice implementation are most often examined within SCCT's choice model. For the purposes of this study, choice goals will be recognized as the extent to

which the participants intend to engage in various math and/or science-related activities in the future.

In summary, self-efficacy, outcome expectations, and interests predict choice goals. The influences of math/science self-efficacy beliefs and outcome expectations on choice goals are partially mediated by one's interests. For instance, feeling efficacious in math along with the expectation of positive outcomes for pursuing math will likely lead to increased interests in math-related activities. These interests, in turn, will most likely lead to choices that coincide with these interests.

### **SCCT Performance Model**

According to SCCT's performance model (Lent et al., 1994), five socio-cognitive variables impact current performance: ability, past performance, self-efficacy beliefs, outcome expectations, and performance goals (Lent et al., 1994). Within SCCT, current performance is conceptualized to include both levels of accomplishment (e.g., GPA) as well as persistence behaviors (e.g., retention in major). As mentioned previously, past performance is the most influential learning experience on the formation of self-efficacy beliefs and outcome expectations. In addition, learning experiences are influenced by both person inputs (i.e., cognitive ability) and background contextual affordances (e.g., access to role models). Therefore, current ability consists of both inherited abilities as well as skills established in prior educational and career experiences. Within SCCT's performance model, ability/skills and past performance both directly and indirectly influence performance through self-efficacy beliefs and outcome expectations.



Positive academic and career-related learning experiences are likely to lead to stronger self-efficacy and more positive outcome expectations. More robust self-efficacy beliefs as well the expectation of positive outcomes in a particular domain result in the establishment of more challenging performance goals. More challenging goals are likely to lead to greater academic and work performance. Self-efficacy beliefs also help individuals organize and execute their skills (Bandura, 1986). Therefore, self-efficacy beliefs also have a direct relation with performance in the SCCT performance model. Finally, depending on the type of performance one has (e.g., passing or failing a class), an individual will re-evaluate the process and make necessary modifications. As a result, performance attainments link back to learning experiences to inform future choices and behavior.

In summary, SCCT hypothesizes that ability and past performance directly and indirectly influence performance via self-efficacy and outcome expectation beliefs. Self-efficacy and outcome expectations influence performance through the establishment of specific goals. The establishment of challenging goals leads to greater performance. Performance is also directly influenced by self-efficacy beliefs. Furthermore, after the performance is completed, an individual may reevaluate their self-efficacy, outcome expectations, interests, and goals depending on the outcome.

### **Role of Contextual Influences**

An underpinning assumption of SCCT is that throughout the academic and career development process an individual's interests, choices, and performance are impacted by

environmental factors (Lent et al., 1994). Within the SCCT model, these environmental factors are recognized as contextual influences. The role of perceived contextual influences on an individual's academic and career process can be understood as either aiding or hindering one's development (Lent et al., 1994). Therefore, contextual influences consist of both perceived supports (e.g., social encouragement, role models/mentors) that serve to assist, as well as perceived barriers (e.g., financial concerns, negative social/family influences) that act as obstructions during one's academic and career formation (Lent et al., 2000).

Contextual influences impact the development of academic and career learning experiences as well as the implementation of academic and career choice (Lent et al., 1994). For example, extreme poverty can significantly limit one's available learning opportunities, as well as restrict one's possible academic and career choices. As a result, SCCT recognizes two different categories of contextual influences. These categories of contextual influences are conceptualized within SCCT as distal and proximal (Lent et al., 1994). Distal contextual influences are the background contextual affordances previously discussed. These include things such as early exposure to role models, parental support during childhood, and gender role socialization. These distal contextual influences impact the learning experiences that shape self-efficacy beliefs and outcome expectations. Proximal contextual influences are environmental factors that directly influence interests, choice goals, and choice actions at important choice points (e.g., experiencing discrimination during a job interview).

Original SCCT (Lent et al., 1994) hypotheses posit that proximal contextual influences moderate the relation between interests and choice goals. For instance, a college student may be interested in Art as a college major, but intends to choose a more prestigious major to satisfy parental expectations. Thus, interests are less likely to be translated into choice goals when environments present little support and a multitude of barriers. Conversely, interests are more likely to be translated into choice goals when environments provide ample support and present few barriers. In addition to the moderator hypotheses, SCCT asserts that contextual influences directly influence academic and career-related choices (Lent et al., 1994). For instance, a student may select the more prestigious major if he or she experiences parental pressure during the choice implementation phase.

Contrary to original SCCT hypotheses, growing support has been found for Bandura's (1997) assertion that contextual influences affect choice goals and actions both directly as well as indirectly via self-efficacy beliefs (see Lent et al., 2005). That is, individuals raised within facilitative environments are more likely to develop strong self-efficacy beliefs, which in turn can increase the likelihood of pursuing specific academic and career-related activities. In comparison, individuals raised within hindering environments are more likely to develop weak self-efficacy beliefs, which in turn can decrease the likelihood of pursuing such activities. Consistent findings of a direct relationship between contextual influences and self-efficacy beliefs has resulted in a modification in the SCCT model (see Figure 2). Whereas the original SCCT hypotheses

(Lent et al., 1994) did not specify a direct path from contextual influences to self-efficacy beliefs, the current SCCT model includes this path.

In summary, original SCCT hypotheses (Lent et al., 1994) highlight the significance of distal and proximal contextual influences on the academic and career development process. Distal contextual influences impact the learning experiences that give rise to self-efficacy beliefs and outcome expectations. The SCCT model also hypothesizes that proximal contextual influences moderate the relationship between interests and choice goals as well as directly impact choice actions. Lastly, recent analyses (e.g., Byars-Winston & Fouad, 2008; Lent et al., 2011) have found competing results to Lent et al.'s (1994) original hypothesis of only a direct relation of contextual influences to choice goals. More specifically, these analyses have found greater support for Bandura's (1997) assertion that contextual influences affect choice goals both directly and indirectly via self-efficacy beliefs.

### **SCCT Research on the Interest Model**

According to SCCT's interest model (Lent et al., 1994), person inputs (e.g., race) and background contextual affordances (e.g., gender socialization) directly affect learning experiences. Learning experiences (e.g., personal performance accomplishments, social persuasion, vicarious learning, and physiological states) directly inform self-efficacy beliefs and outcome expectations. Self-efficacy beliefs and outcome expectations together predict interest within a certain domain. That is, strong self-efficacy beliefs and more positive outcome expectations within a specific domain give rise to interests in that

domain. For example, students are more likely to be interested in math/science when they feel efficacious in performing math/science-related activities and expect positive outcomes for pursuing those activities.

Early investigations found mixed support for Bandura's (1986) and Lent et al. (1994) hypothesis that self-efficacy beliefs and outcome expectations are derived from personal performance accomplishments, social persuasion, vicarious learning, and physiological states. For instance, Lent, Lopez, and Bieschke (1991) examined the impact of personal performance accomplishments, vicarious learning, social persuasion, and physiological states on the math self-efficacy beliefs of undergraduate college students. The results of the study revealed strong bivariate correlations between self-efficacy and the four informational sources. However, a hierarchical regression revealed that vicarious learning, social persuasion, and physiological states did not account for any significant unique variance in math self-efficacy beyond that of personal performance accomplishments. This finding supported Bandura's (1986) hypothesis that performance accomplishments are the strongest contributor to the development of self-efficacy beliefs. Lopez, Lent, Brown, and Gore (1997) found only two of the four learning experiences (i.e., personal performance accomplishments and social persuasion) significantly related to math self-efficacy in their sample of high school students. More specifically, findings suggested only personal performance accomplishments significantly related to math self-efficacy beliefs in both of the samples investigated (samples of high-school students enrolled in geometry versus algebra courses were examined separately).

Turner, Steward, and Lapan (2004) investigated the influence of background contextual affordances and person inputs on math/science self-efficacy, outcome expectations, and math/science interests with a sample of sixth graders. More specifically, they examined the relationship of background contextual factors (e.g., mother support and father support) and person inputs (e.g., career gender typing) on math/science self-efficacy, outcome expectations, and math/science interests. Consistent with SCCT hypotheses they found mother and father support directly related to math/science self-efficacy beliefs and that mother support directly related to outcome expectations. That is, they found the presence of ample parental support to result in greater math/science self-efficacy beliefs and mother support to specifically result in more positive outcome expectations. In addition, they found career gender typing was negatively related to both math/science self-efficacy and outcome expectations. Consequently, an increase in gender typing was associated with lower math/science self-efficacy beliefs and less positive outcome expectations.

Similarly, Fouad and Smith (1996) examined the impact of person inputs (gender and age) on the SCCT interest model using a sample of middle school students and found gender significantly related to outcome expectations specific to math. More specifically, they found that male students had higher outcome expectations when compared to the female students in the study. Counter to previous investigations (e.g., Betz & Hackett, 1983; Lent et al., 1991), they did not find a significant relation between gender and math self-efficacy beliefs. These previous investigations had revealed that

male students had higher math self-efficacy beliefs when compared to the female students in the study.

The constructs of self-efficacy and outcome expectations have traditionally been examined in the domain of mathematics and science (e.g., Betz & Hackett, 1983; Fouad & Smith, 1996; Gainor & Lent, 1998; Lent et al., 1991; Lent et al., 2001; Lopez & Lent, 1992; Post et al., 1991; Waller, 2006). Within these investigations self-efficacy beliefs have consistently been found to directly and positively relate to outcome expectations (e.g., Fouad & Smith, 1996; Waller, 2006). That is, higher self-efficacy beliefs have been found to be associated with more positive outcome expectations. For instance, Fouad and Smith (1996) found a standardized path coefficient of .55 between math self-efficacy and outcome expectations. Waller (2006) found a similar result in his investigation with non-traditional African American college students (standardized path coefficient = .44). Moreover, a recent meta-analysis investigating SCCT studies classified within Holland themes (Sheu et al., 2010) revealed a moderate and significant relation between self-efficacy and outcome expectations in the Investigative theme (i.e., math and science-related domains). This finding is consistent with Lent et al.'s (1994) original meta-analytic finding of a moderate to large bivariate relation between self-efficacy beliefs and outcome expectations ( $r = .49$ ). Thus, consistent with Bandura (1997) and Lent et al. (1994), self-efficacy beliefs appear to serve as a source of outcome expectations. More specifically, individuals tend to perceive positive outcomes in domains in which they feel efficacious in performing.

In addition to informing outcome expectations, math/science self-efficacy beliefs have been found to be a strong predictor of interests. In other words, consistent with original SCCT hypotheses (Lent et al., 1994), research suggests a positive association exists between math/science self-efficacy beliefs and math/science-related interests. For instance, Rottinghaus, Larson, and Borgen (2003) in their meta-analytic investigation found a correlation of .59 between self-efficacy beliefs and interests. In addition, they examined the bivariate relations between self-efficacy beliefs and interests across Holland's RIASEC themes and found the relations between self-efficacy beliefs and interests to be strongest in the Investigative theme ( $r = .68$ ). Extensive research has demonstrated the capability of math/science self-efficacy beliefs to predict interests in STEM academic and career fields (e.g., Betz & Hackett, 1983; Byars-Winston & Fouad, 2008; Fouad & Smith, 1996; Lent et al., 2001; Post, Stewart, & Smith, 1991, Quimby et al., 2007; Waller, 2006).

Several of these studies have found that the inclusion of outcome expectations, along with math/science self-efficacy, significantly predicts interest in math/science academic and career fields (Fouad & Smith, 1996; Gainor & Lent, 1998; Lent et al., 2001; Quimby et al., 2007). In these investigations higher math/science self-efficacy and more positive outcome expectations are found to significantly predict the presence of stronger math/science-related interests. The results from these studies are consistent with SCCT (Lent et al., 1994) hypotheses which suggest that the best predictor of interest in a particular career field may be the consideration of both self-efficacy and outcome



expectations. Lent et al. (1994) found a similar bivariate correlation between self-efficacy beliefs and interests as that between outcome expectations and interests in their original meta-analytic investigation ( $rs = .53$  and  $.52$ , respectively).

Quimby and colleagues (2007) examined the math/science self-efficacy and outcome expectations of environmental science college students and found these constructs to be significant predictors of their interest in environmental science. Turner et al. (2004) also found math/science self-efficacy beliefs and outcome expectations to have a significant and positive relation to math/science career interests in their sample. This result was consistent with the findings from a an earlier study that demonstrated that math-related self-efficacy and outcome expectations were significant predictors of math-related interests in a sample of undergraduate college students (Lent et al., 2001). Similarly, a more recent study found a significant and moderate relationship between undergraduate college student's math/science self-efficacy and interests as well as between their math/science outcome expectations and interests (Byars-Winston and Fouad, 2008). Finally, in a recent meta-analytic investigation (Sheu et al., 2010), moderate path coefficients for the relations of both self-efficacy and outcome expectations to interests were uncovered for existing SCCT studies classified in the Investigate Holland theme ( $rs = .43$  and  $.33$ , respectively).

In summary, partial support has been revealed for SCCT's and Bandura's hypotheses that the four sources of learning experiences (e.g., personal performance accomplishments, social persuasion, vicarious learning, and physiological states)

substantially contribute to the formation of self-efficacy beliefs. However, the testing of these hypotheses has not received the research attention that other SCCT examinations have received. Support has been found for Bandura's hypothesis that personal performance accomplishments are the strongest contributor to the formation of self-efficacy beliefs. SCCT investigations have revealed overwhelming support for the original hypothesis suggesting that self-efficacy beliefs serve as a source of outcome expectations. Moreover, consistent support has been found for the hypothesis that both self-efficacy and outcome expectations predict domain specific interests. SCCT studies specifically examining the math/science domain have revealed consistent findings of strong relations between math/science self-efficacy beliefs, outcome expectations, and math/science-related interests.

### **SCCT Research on the Choice Model**

According to SCCT's choice model (Lent et al., 1994), individuals choose academic and career fields that are consistent with their self-efficacy beliefs, outcome expectations, and interests. The influence of self-efficacy beliefs and outcome expectations on choice intentions is largely mediated by interests. More specifically, strong self-efficacy beliefs and positive outcome expectations within a specific domain increase interests in that domain. These interests, in turn, result in a greater likelihood of pursuing academic and career choices specific to that domain. For the purposes of this study, choice intentions will be recognized as choice goals or the extent to which the participants intend to engage in various math and/or science-related activities in the

future. This operationalization of choice goals is consistent with previous studies of math/science social cognitive variables (Lent et al., 2001; Byars-Winston & Fouad, 2008).

Self-efficacy beliefs have been found to significantly and positively relate to choice goals in SCCT studies involving the STEM fields (Byars-Winston & Fouad, 2008; Lent, Brown, Schmidt, et al., 2003; Lent et al., 2005; Lent et al., 2011; Waller, 2006). In other words, stronger self-efficacy beliefs in STEM domains have found to be associated with higher STEM-related choice goals. For instance, Lent, Brown, Schmidt, et al. (2003) found a standardized path coefficient of .44 between self-efficacy and choice goals in their investigation with engineering majors. Waller (2006) found a similar standardized path coefficient between math self-efficacy and math choice intentions (.38) in his investigation with African American non-traditional college students. These findings were consistent with the bivariate correlation reported by Lent et al. (1994) in their original meta-analytic investigation ( $r = .40$ ). Furthermore, Waller (2006) found the relation between math self-efficacy and math choice intentions was smaller than the relation between math self-efficacy and math interests (standardized path coefficients = .38 versus .48, respectively). Meta-analytic findings by Sheu et al. (2010) also found the direct relation of self-efficacy to choice goals in math and science domains to be smaller than those between interests and choice goals. Overall, interests were found to partially mediate the influence of self-efficacy beliefs on choice goals in both of these studies. Higher math/science self-efficacy beliefs were associated with greater math/science-

related interests, which in turn resulted in greater math/science-related choice goals.

Outcome expectations have also been found to relate to STEM-related choice goals (Byars-Winston & Fouad, 2008; Lent et al., 2001; Sheu et al., 2010). More positive outcome expectations for involvement in STEM domains have been associated with greater STEM-related choice goals. However, the direct relation of outcome expectations to choice goals is less conclusive (when compared to the relation of self-efficacy beliefs to choice goals) in SCCT studies involving the STEM fields. More specifically, while some studies (e.g., Lent et al., 2005; Lent et al., 2011; Waller, 2006) have failed to find a significant relation between outcome expectations and interests, other studies have found a significant and moderate relation (e.g., Byars-Winston & Fouad, 2008; Lent et al., 2001). For example, Waller (2006) did not find a significant relation between outcome expectations and choice intentions in his investigation (standardized path coefficient = .01). This finding was consistent with a previous study of the STEM-related choice intentions of engineering majors (Lent et al., 2005; standardized path coefficient = .08). However, Byars-Winston & Fouad (2008) and Lent et al. (2001) did find a significant and moderate relation between outcome expectations and choice goals in their investigations (standardized path coefficients = .42 and .36, respectively). Both of these studies specifically examined the SCCT model using math and science social cognitive variables.

A recent meta-analytic investigation revealed a moderate and significant path between outcome expectations and choice goals for existing SCCT studies classified

within Holland's Investigative theme (Sheu et al., 2010; standardized path coefficient = .42). This finding was consistent with original SCCT meta-analytic findings (Lent et al., 1994) of a moderate bivariate correlation between outcome expectations and choice goals ( $r = .42$ ). Additionally, Lent and colleagues (2001) found the relation of outcome expectations and choice goals to be smaller than the relation between outcome expectations and interests (standardized path coefficients = .36 versus .41, respectively). Overall, Lent and colleagues (2001) found the relation between outcome expectations and choice goals to be partially mediated by interests. In other words, more positive outcome expectations were associated with greater math/science-related interests, which in turn, resulted in greater math/science-related choice goals.

Sheu and colleagues (2010) in their meta-analytic investigation of existing SCCT studies found support for SCCT's choice model hypotheses. More specifically, they found the relations of self-efficacy and outcome expectations to choice goals to be partially mediated by interests. A study by Fouad and Smith (1996) revealed that middle school student's math/science self-efficacy beliefs significantly and positively impacted their interests in math/science domains. Furthermore, their interests were predictive of their high school enrollment intentions for math and science. These investigations support SCCT's original hypotheses that both self-efficacy and outcome expectations have a direct relation to choice goals as well as indirect relation through interests.

A review of the SCCT literature reveals numerous studies (c.f. Lent et al., 2001; Byars-Winston & Fouad, 2008; Sheu et al., 2010) replicating the original meta-analytic

findings (Lent et al., 1994) of a direct and positive relation between interests and choice goals. In other words, strong interests in a particular domain have been found to result in greater intentions to pursue an academic major or career within that domain. For instance, Sheu et al. (2010) in their meta-analytic investigation found a moderate standardized path coefficient (.35) between interests and choices for studies classified within Holland's Investigative theme. Lent et al. (2001) and Byars-Winston & Fouad (2008) found comparable results in their investigations of interests and choices in math/science with general undergraduate student samples (standardized path coefficients = .49 and .42, respectively). Lent et al. (1994) in their original meta-analytic investigation found a strong bivariate correlation between interests and choice goals ( $r = .60$ ). This finding was similar to the bivariate correlation ( $r = .71$ ) reported by Waller (2006) in his investigation of the math interests and choice intentions of non-traditional African American college students.

In summary, there is a large body of research to support SCCT's choice model which asserts that self-efficacy beliefs, outcome expectations, and interests are related to choice goals. Subsequent SCCT studies have found support for original SCCT hypotheses that suggest the relation of self-efficacy beliefs and outcome expectations on choice goals is partially mediated by interests. Lastly, SCCT studies have consistently found interest to significantly and positively relate to choice goals.

### **SCCT Research on the Performance Model**

As previously stated, the hypotheses for SCCT's performance model indicate ability/past performance relates to current performance both directly and indirectly through self-efficacy and outcome expectations (Lent et al., 1994). Self-efficacy and outcome expectations, subsequently, influence the establishment of performance goals. These performance goals directly influence performance (i.e., more challenging goals lead to greater performance). In addition, original SCCT hypotheses posit that self-efficacy beliefs have a direct affect on performance (Lent et al., 1994). Lastly, SCCT hypotheses suggest that performance outcomes link back to learning experiences to inform future choices and behavior.

Lopez and colleagues (1997) examined SCCT's performance model with a sample of high school students enrolled in two math courses (algebra and geometry). They specifically tested SCCT performance model paths separately for students enrolled in algebra versus geometry courses. Consistent with SCCT hypotheses, in both samples, math ability (i.e., SAT scores) and perceived past performance in math were found to indirectly relate to current performance (i.e., end of the term math grade) through math self-efficacy beliefs. Thus, greater math ability and higher perceptions of past success in math resulted in greater math self-efficacy beliefs. Greater math self-efficacy beliefs, in turn, resulted in a stronger performance in the math courses. Counter to SCCT hypotheses, in both samples, the influence of perceived past performance on current performance was fully mediated by math self-efficacy beliefs. That is, past performance

did not have a direct affect on current performance. In both samples, math ability helped facilitate performance directly (i.e., greater math ability lead to greater performance). Lastly, also consistent with SCCT hypotheses, math self-efficacy was found to directly affect performance in both samples. Results revealed that stronger math self-efficacy beliefs were associated with greater performance in the math courses.

Robbins, Lauver, Le, Davis, Langley, and Carlstrom (2004) conducted a meta-analysis examining the relations of several academic and psychological variables (e.g., self-efficacy and academic goals) to college performance (e.g., GPA) and persistence (e.g., college retention). Consistent with SCCT hypotheses, Robbins and colleagues (2004) found ability (e.g., ACT/SAT scores) to have a moderate bivariate correlation with academic self-efficacy beliefs ( $r = .28$ ). In addition, they found past performance (e.g., high-school GPA) to be strongly related to academic self-efficacy beliefs ( $r = .70$ ). Robbins and colleagues (2004) found moderate to strong correlations between ability and current performance as well as between past performance and current performance ( $r_s = .39$  and  $.45$ , respectively). The results of the meta-analysis also revealed small to moderate correlations between ability and persistence as well as between past performance and persistence ( $r_s = .12$  and  $.25$ , respectively).

Consistent with SCCT hypotheses, they found self-efficacy beliefs to be moderately to strongly related to academic goals ( $r = .49$ ), performance ( $r = .50$ ), and persistence ( $r = .36$ ). Academic goals were correlated  $.18$  with current performance and  $.34$  with persistence. These findings provide strong support for SCCT's performance



model. More specifically, that higher ability/past performance is associated with more positive self-efficacy beliefs and increased performance/persistence. Additionally, that greater self-efficacy is associated with more challenging goal setting behavior as well as increased performance/persistence. Furthermore, that the development of more challenging performance goals is associated with greater performance and persistence.

Combining meta-analytic and structural equation modeling methodologies, Brown, Tramayne, Hoxha, Telander, and Lent (2008) used the unbiased correlations from the Robbins et al. (2004) study to test SCCT performance model hypotheses for the relations between ability/past performance, self-efficacy, performance goals, and performance. Two models of performance were separately assessed (a model using college GPA to represent the outcome variable as well as a model using college retention criteria to represent the outcome variable). In addition, two models using separate definitions of ability/past performance were compared. More specifically, a model using cognitive ability (measured by ACT/SAT scores) to operationalize ability/past performance was compared to a model using past performance (high school GPA) to operationalize ability/past performance. Hypotheses examining the role of outcome expectations in SCCT's performance model were not assessed due to an insufficient number of correlations available to fully assess the role of outcome expectations in SCCT's performance model.

Brown and colleagues (2008) found the model that operationalized ability/past performance as cognitive ability (i.e., ACT/SAT scores) provided the best fit to the data.

In particular, they found that cognitive ability directly related to current performance while past performance (i.e., high school GPA) only related to current performance through self-efficacy beliefs. The finding of a direct relation between cognitive ability and performance is consistent with original SCCT hypotheses (Lent et al., 1994). Brown and colleagues (2008) found past performance (e.g., high school GPA) to have a stronger relation to self-efficacy when compared to the relation between cognitive ability and self-efficacy. Therefore, past performance appeared to be a robust predictor of self-efficacy beliefs. This finding is consistent with hypotheses by both Bandura (1986) and SCCT (Lent et al., 1994), which posit that past performance has its greatest influence on the development of self-efficacy beliefs.

Cognitive ability was found to significantly relate to current performance in the study (Brown et al., 2008). More specifically, cognitive ability had both a direct and indirect (via academic self-efficacy beliefs) relation to performance. Greater cognitive ability was associated with higher academic self-efficacy beliefs as well as stronger performance. Cognitive ability was not found to directly relate to persistence. However, an indirect relation for cognitive ability on persistence through academic self-efficacy beliefs and goals was uncovered. Greater cognitive ability was associated with more positive academic self-efficacy beliefs, which were then associated with stronger performance goals. These stronger performance goals were then associated with a greater likelihood to complete college. Brown and colleagues (2008) suggested this finding may indicate that academically able students may be no more likely to finish

college then less academically able students if they don't develop the necessary academic self-efficacy beliefs and goals for college completion. Self-efficacy beliefs were found to directly relate to academic goals in both models. Stronger academic self-efficacy beliefs were associated with stronger performance goals in both instances.

Surprisingly, academic goals were not found to relate to college GPA in the performance model examination (Brown et al., 2008). Consequently, the effect of ability/past performance on current performance was fully mediated by academic self-efficacy in the model. This is counter to SCCT hypotheses which indicate that both academic goals and self-efficacy beliefs mediate the influence of ability/past performance on performance.

Brown, Lent, Telander, and Tramayne (2011) used meta-analytic path analysis methodology to once again test variations in SCCT's performance model. Whereas the Brown et al. (2008) meta-analysis examined the SCCT performance model within the context of academic performance, this meta-analysis examined the SCCT performance model specific to work performance. Once again, the role of outcome expectations in SCCT's performance model was not assessed due to an insufficient number of studies available that examined the role of outcome expectations on performance.

Brown and colleagues (2011) found cognitive ability to positively relate to work performance in the meta-analysis. Consistent with the previous meta-analytic findings (Brown et al., 2008) and original SCCT hypotheses (Lent et al., 1994), cognitive ability was found to relate to work performance both directly and indirectly through self-efficacy

beliefs. Greater cognitive ability was associated with higher self-efficacy beliefs and stronger performance. Counter to original SCCT hypotheses, a direct and positive relationship was found between cognitive ability and performance goals. This finding suggested that greater cognitive ability was associated with the establishment of more challenging work-related performance goals. Consistent with original SCCT hypotheses (Lent et al., 1994) and previous findings (Brown et al., 2008), self-efficacy beliefs had a significant and positive relationship with performance goals. That is, higher self-efficacy beliefs were associated with the establishment of more challenging performance goals.

Consistent with the Brown et al. (2008) meta-analysis, but counter to original SCCT hypotheses, a direct and significant relation between performance goals and performance was not supported in the findings. Brown and colleagues (2011) suggested that the finding of a nonsignificant relation between performance goals and performance (both in this study as well as the Brown et al. 2008 study) may indicate that performance goals add little unique variance to performance beyond that accounted for by ability/past performance and self-efficacy. For instance, it may be possible that both goals and self-efficacy account for similar motivational incentives in performance (e.g., approaching challenging tasks, sustained effort, and persistence in the face of obstacles).

In summary, the research on SCCT's performance model has revealed consistent findings of a direct relation between past performance/ability and self-efficacy beliefs. Stronger self-efficacy beliefs have been shown to result in stronger performance goals. Moreover, findings have also supported SCCT original hypotheses of a direct relation

between self-efficacy beliefs and performance as it pertains to both work and academic domains. Consistent findings of a direction relation between performance goals and performance have not been established in the literature and warrant further investigation. In addition, few studies in the SCCT literature directly examine the role of outcome expectations in the performance model. While this study will not specifically test hypotheses related to SCCT performance model, a review of the literature does suggest that variables examined in this study may warrant investigation within the model. More specifically, studies investigating the role of contextual influences and coping efficacy in the performance model are lacking in the SCCT literature.

### **SCCT Research on Contextual Influences**

According to SCCT (Lent et al., 1994), contextual influences impact the academic and career development process in two critical phases. First, contextual affordances that occur during childhood, adolescence, and young adulthood (e.g., distal contextual influences) impact the early learning experiences that give rise to self-efficacy beliefs and outcome expectations. For instance, limited learning opportunities such as not having access to an adequate education can seriously hinder the development of strong academic-related self-efficacy beliefs and the expectation of positive outcomes for continuing one's education. As previously mentioned, these distal contextual affordances impact the formation of interests and subsequently were discussed above in SCCT's interest model. In addition, contextual influences also impact the career development process during the choice making phase. These contextual influences, recognized in

SCCT as proximal contextual influences, will be discussed in this section. Proximal contextual influences that occur during the choice making phase include both enhancing social-environmental factors (i.e., supports) and impeding social-environmental (i.e., barriers) factors.

Original SCCT hypotheses (Lent et al., 1994) suggested that proximal contextual influences impact the choice making process in two ways. First, contextual influences moderate the relation between interests and choice goals. That is, the relation between one's academic or career-related interests and choice goals will be stronger for individuals who perceive ample support and few barriers. Conversely, the relation between one's interests and choice goals will be weaker for those who perceive significant barriers and few supports. Second, contextual influences also directly impact choice actions. For instance, having limited financial resources can significantly reduce the likelihood that particular choices (e.g., going to medical school) are realized. In addition to these original SCCT hypotheses, another path has been introduced into the SCCT model due to recent findings within the model (e.g., Lent et al., 2001; Lent et al., 2005; Lent et al., 2011). More specifically, the current SCCT model includes a direct path from proximal contextual influences to self-efficacy beliefs in addition to the original direct path from proximal influences to choice goals. This path is consistent with Bandura's (1997) assertion that contextual influences affect choice goals both directly and indirectly via self-efficacy beliefs.

Lent and colleagues (2000) suggested that future SCCT studies assess contextual

influences in relation to specific choice options. Since this declaration, numerous SCCT studies examining the impact of contextual influences on STEM-related choices have followed (Byars-Winston & Fouad, 2008, Fouad et al., 2010; Lent et al., 2001, Lent, Brown, Schmidt, et al., 2003; Lent et al., 2005; Lent et al., 2011; Quimby et al., 2007). Across these studies supports and barriers have been found to significantly impact the formation of interests as well as the pursuit of specific STEM-related college majors and career choices. For example, Fouad et al. (2010) examined barriers and supports specifically related to the pursuit of coursework or careers in the math and science domain. Based on their findings, they suggested that the presence of just a few barriers in this particular domain may be enough to result in a student electing out of math and science-related domains.

Fouad et al. (2010) found significant negative correlations between both math barriers and math supports as well as between science barriers and science supports. Previous SCCT studies examining the pursuit of STEM fields have also found significant negative correlations between supports and barriers (Lent et al., 2001; Lent, Brown, Schmidt, et al., 2003; Lent et al., 2005, Lent et al., 2011). For instance, Lent, Brown, Schmidt et al (2003) found perceived supports and barriers specific to the pursuit of an engineering major were significantly correlated ( $r = -.22$ ) in their investigation. This result is consistent with the meta-analytic finding of a statistically significant bivariate relation between supports and barriers ( $r = -.20$ ) in existing SCCT studies classified within Holland's Investigative theme (Sheu et al., 2010).

Lent et al. (2001) tested SCCT's original hypothesis that supports and barriers would moderate the relation of interests to choice goals. Within this investigation they explicitly examined the math/science intentions of undergraduate college students. They found mixed support for SCCT's original hypotheses. More specifically, they found interests were strongly related to choice goals in the low barrier environment, but not in the high support environment. Consequently, the perception of few barriers did increase the likelihood that math/science interests were translated into choice goals but the perception of high support did not impact the likelihood that math/science interests were translated into math/science-related choice goals. A review of the literature specific to STEM fields revealed that this was the only study that directly examined this hypothesis. Consequently, further investigations for this hypothesis within STEM domains is needed test the accuracy of the original SCCT hypothesis that supports and barriers moderate the relationship between interests and choices.

Several SCCT examinations of STEM-related interests and choices have found support for SCCT's hypothesis that contextual influences directly impact choice goals (Lent et al., 2005; Lent et al., 2011; Sheu et al., 2010). For instance, Lent et al. (2011) found both supports and barriers to relate to the choice goals of computing majors. Supports were found to positively relate to choice goals (standardized path coefficient = .13) and barriers were found to negatively relate to choice goals (standardized path coefficient = -.10). Thus, the perception of greater support was associated with higher choice goals specific to the computing domain while the perception of higher barriers



was related to fewer choice goals specific to the computing domain. Lent et al. (2005) found similar results in their investigation of engineering majors. More specifically, they found barriers were significantly and inversely related to choice goals specific to engineering. However, they did not find a statistically significant relation between supports and choice goals in their examination. Sheu et al. (2010) found a similar result in their meta-analytic investigation of SCCT studies classified within Holland themes. They found barriers were significantly related to choice goals in the Investigative theme (standardized path coefficient =  $-.07$ ), however, they did not find a statistically significant relation between supports and choice goals within this domain (standardized path coefficient =  $.02$ ).

As previously mentioned, recent analyses have found competing results to Lent et al.'s (1994) original hypothesis that contextual influences only have a direct affect on choice goals (Byars-Winston & Fouad, 2008; Lent et al., 2001; Lent, Brown, Nota, et al., 2003; Lent, Brown, Schmidt et al., 2003; Lent et al., 2005; Lent et al., 2011). More specifically, these analyses have found greater support for Bandura's (1997) assertion that contextual influences also affect choice goals through a relation with self-efficacy beliefs. Thus, rather than only influencing choice goals directly, the research suggests that supports facilitate the acquisition of self-efficacy beliefs in specific career areas (e.g., STEM careers). At the same time, barriers hinder the acquisition of career-related self-efficacy beliefs. These respective self-efficacy beliefs then influence the types of interests that people develop and these interests, subsequently, influence the choices

people make.

For instance, Lent Brown, Schmidt et al. (2003) found supports and barriers to indirectly influence choice goals specific to engineering only through their relation with self-efficacy beliefs. In other words, they found that the impact of supports and barriers on choice goals were fully mediated by self-efficacy beliefs. Lent et al. (2001) and Lent, Brown, Nota, et al. (2003) examined two competing models to test SCCT's hypothesis of a direct link between contextual influences and goals. In both examinations, the first model specified supports and barriers to only have a direct relation with choice goals, while the alternative model specified an additional indirect relation through self-efficacy beliefs. Comparing model fit, Lent and colleagues revealed greater support for the model specifying supports and barriers to have an indirect relation to choice goals, through self-efficacy beliefs.

Sheu et al. (2010) also found the influence of supports and barriers on math/science-related choice goals to be mediated by self-efficacy beliefs in their meta-analytic investigation of SCCT studies classified by Holland themes. Interestingly, they also found outcome expectations to partially mediate the relation of supports and barriers to choice goals for SCCT studies classified within the Investigative theme. More specifically, they found a standardized path coefficient of .23 between supports and outcome expectations, a standardized path coefficient of -.06 between barriers and outcome expectations, and a standardized path coefficient of .42 between outcome expectations and interests. The moderate relation between supports and outcome

expectations suggests that supports may be particularly helpful in the promotion of outcome expectations in math and science-related domains. Finally, a recent study by Byars-Winston and Fouad (2008) discovered that the relation between barriers and the math/science choice goals of undergraduate students was mediated through coping efficacy beliefs, not self-efficacy beliefs.

In summary, numerous SCCT studies have found evidence suggesting that supports and barriers are inversely related. That is, greater support is associated with fewer perceived barriers. SCCT studies specific to STEM fields have found mixed support for the SCCT hypothesis (albeit only one study was found in the literature that specifically examined this hypothesis) that supports and barriers moderate the relation of interests to choice goals. More specifically, Lent and colleagues (2001) found interests moderated the relation between barriers and choice goals when few barriers were perceived but that the perception of high support did not impact the relationship between interests and choice goals. Mixed evidence has also been found for SCCT's original hypothesis that contextual influences directly impact choice goals. Some investigations have found both supports and barriers to directly influence choice goals while others have found only supports or barriers to have a direct impact on choice goals. Numerous studies have found results consistent with Bandura's (1997) assertion that contextual influences directly influence self-efficacy beliefs. In addition, a recent meta-analytic investigation also found evidence suggested that supports directly influence outcome expectations. Lastly, a recent investigation found that the relation between barriers and

choice was mediated through coping efficacy beliefs rather than self-efficacy beliefs.

### **Summary**

This chapter provided a description of the full Social Cognitive Career Theory (SCCT; Lent et al., 1994) model and evaluated existing SCCT research. A review of the SCCT literature revealed numerous research findings specific to math and science that corroborated original SCCT hypotheses (Lent et al., 1994). More specifically, outcome expectations have consistently been found to relate to math/science self-efficacy beliefs. That is, people with strong math/science self-efficacy beliefs have seen more positive outcomes from involvement in math/science. In addition, math/science self-efficacy beliefs and outcome expectations have consistently been found to relate to math and science interests and choice goals. Moreover, the relationships between math/science self-efficacy beliefs and outcome expectations to choice goals have been found to be mediated by math and science interests. That is, stronger math/science self-efficacy beliefs and more positive outcome expectations have resulted in greater math and science interests, which in turn, have resulted in stronger choice goals for math and science. Lastly, math and science-related supports have demonstrated a positive and moderate relation with outcome expectations. In other words, greater support in the math and science domain has been found to raise relevant outcome expectations for involvement in the math and science domain.

A review of the SCCT literature also reveals several areas that warrant further investigation within the math and science domain. For instance, Lent and colleagues

(2000) suggested that coping efficacy and self-efficacy are theoretically distinct, but related constructs. More specifically, they suggested that task self-efficacy is reflective of the confidence needed to successfully complete a task, while coping efficacy is representative of the confidence needed to manage situational features complicating that task. However, SCCT examinations of STEM-related interests and choices have not traditionally examined these constructs separately (Lent et al., 2001; Lent, Brown, Schmidt, et al., 2003; Lent et al., 2005; Lent et al., 2011). Moderate correlations between coping efficacy scores and task self-efficacy scores, such as those found by Byars-Winston and Fouad (2008) of .42 and those of Lopez and Yi (2006) of .43, suggest that these variables represent different constructs. These findings, in addition to theoretical propositions that the variables represent distinct constructs, warrant the examination of coping efficacy beliefs as separate from self-efficacy beliefs.

Lent et al. (2000) proposed that coping efficacy could mediate the influence of perceived barriers on choice goals or could potentially moderate the influence as well. However, the role of coping efficacy in the SCCT model has yet to be clarified. The results of a recent study, examining the influence of social cognitive variables on undergraduate college student's math/science choice goals, revealed that the effect of perceived barriers on math/science self-efficacy beliefs were mediated by coping efficacy beliefs (Byars-Winston & Fouad, 2008). The study found perceived career barriers to decrease coping efficacy beliefs, which in turn, resulted in lower math/science self-efficacy beliefs (Byars-Winston & Fouad, 2008). Studies by Lent and colleagues (2001;

Lent, Brown, Schmidt, et al., 2003; Lent et al., 2005; Lent et al., 2011) have also found robust efficacy beliefs to mediate the relation of perceived supports and barriers to STEM-related interests and choice goals. However, these studies used a latent variable of self-efficacy beliefs with coping efficacy and task self-efficacy serving as indicators.

Bandura's (1997) has asserted that perceived barriers or obstacles may not have the same effect on the behaviors of individuals' who exhibit high levels of coping efficacy. This assertion implies that coping efficacy may have a moderating role in the relation between perceived barriers and self-efficacy beliefs. This declaration was echoed by Hackett and Byars (1996) who proposed that African American women possessing high coping efficacy beliefs could experience successful performances despite expectations of encountering racism or discrimination in their academic or career pursuits. The proposition that coping efficacy may serve as a moderator in the relationship between perceived barriers and math/science self-efficacy beliefs has yet to be examined.

Finally, several studies using the SCCT model (Byars-Winston & Fouad, 2008; Lent et al., 2001; Lent, Brown, Nota, and Soresi, 2003; Lent, Brown, Schmidt, et al., 2003) have examined how contextual influences affect choice goals in math and science. However, while some investigations have found evidence for self-efficacy to fully mediate the influence of contextual influences to goals (e.g., Lent et al., 2001), other studies reveal support for a partially mediated relation of contextual influences to goals (e.g., Lent et al., 2011). In addition, some investigations (e.g., Lent et al., 2005) have

revealed nonsignificant path coefficients between supports and choice goals, suggesting a partially mediated relation between barriers and choice goals but a fully mediated relation between supports and choice goals. Thus, further examinations are warranted in order to better understand how math and science-related supports and barriers relate to choice goals specific to math and science.

## CHAPTER THREE

### METHODOLOGY

#### **Participants**

The sample consisted of 246 undergraduate students with a mean age of 23.88 years ( $SD = 8.44$ , range = 18 - 68). Women comprised 78.5% ( $n = 193$ ) and men comprised 21.1% ( $n = 52$ ) of the sample (one individual did not report their gender). The majority of the sample was Caucasian ( $n = 153$ ; 62.2%). The remainder of the sample included 46 (18.7%) African Americans, 18 (7.3%) Mexican Americans or others of Hispanic descent, 15 (6.1%) Asian Americans, and 10 (4.1%) individuals identified as multi-racial. A total of 3 (1.2%) participants indicated their race/ethnicity to be “other,” while one failed to answer this demographic question. The majority of the sample reported that their family of origin's SES was middle class ( $n = 134$ ; 54.5%). The remainder of the participants identified their family of origin's SES as poor ( $n = 17$ ; 6.9%), lower-middle class ( $n = 34$ ; 13.8%), upper-middle class ( $n = 56$ ; 22.8%), and upper class ( $n = 5$ ; 2.0%).

In terms of year in college, 24.4 % of participants reported being in their first year of study, 20.7 % in their second year, 26.0% in their third year, 17.9% in their fourth year, and 10.6% beyond their fourth year (one individual did not report their current year in school). Forty-nine different academic majors were represented in the sample with 29.3% ( $n = 72$ ) reporting math/science-related majors. The mean self-reported high



school grade point average for the sample was 3.53 ( $SD = .56$ ) while the mean self-reported current grade point average was 3.38 ( $SD = .47$ ).

### **Procedures and Instruments**

The participants for this study consisted of undergraduate students attending one of two universities located in the Midwest. Institutional Review Board (IRB) approval was obtained from both universities (see Appendix A). One of the universities was located in an urban setting (Loyola University Chicago) while the other was located in a suburban setting (Governors State University). Undergraduate students completing coursework in various classes (e.g., introductory psychology, statistics, adolescent development, and identity and pluralism) were recruited for inclusion in this study to attempt to ensure that a wide range of scores would be obtained on the measures used in this study. During class hours packets were distributed to the students who volunteered to participate. The first page of the packet contained a consent form (see Appendix B) explaining the purpose of the study, confidentiality, the voluntary nature of the study, and any potential risks associated with their participation. To ensure confidentiality no self-identifying information was asked in the packet. The packet also contained a demographic questionnaire and measures of contextual influences, coping efficacy, math/science self-efficacy, outcome expectations, interests, and choice goals (see Appendices C, D, E, F, G, H, and I, respectively). It took the students approximately 15-20 minutes to complete the packet of questionnaires.

### **Demographic Questionnaire**

A demographic questionnaire was developed for the study. The questionnaire consisted of questions designed to gather information about the students' backgrounds. Information was obtained regarding their age, gender, racial/ethnic identification, family of origin SES, parental education backgrounds, year in school, self-reported current and final high-school GPA's, and current or intended major.

### **Contextual Influences**

Contextual influences were assessed using a domain-specific (math/science) perceived barrier and support measure developed by Lent et al. (2001). This 36-item measure assesses students' beliefs in the likelihood that they will encounter various barriers (21 items) and supports (15 items) in their pursuit of a math/science college major or career. Responses are given on a 5-point scale ("1 = *not at all likely*" to "5 = *extremely likely*") with higher scores on the Support Scale (i.e., "get encouragement from your friends for pursuing this major") indicating the perception of greater supports and higher scores on the Barrier Scale (i.e., "receive unfair treatment because of your racial or ethnic group") indicating the perception of greater barriers to be encountered. Mean scores for each participant on both the Support Scale and Barrier Scale were used in this study (obtained by summing each subject's score and dividing by the number of items on the scale).

Scores on these two scales produced theory-consistent relations with task self-efficacy beliefs, coping-efficacy beliefs, and goals in the Lent et al. (2001) study. Scores

on the Barriers Scale were found to be inversely related to scores on measures of task self-efficacy beliefs, coping-efficacy beliefs, and goals, while scores on the Supports Scale were found to be positively related to scores on these measures. Lent et al. (2001) reported internal consistencies of .90 for scores on the perceived barriers subscale and .88 for scores the supports subscale with their sample of undergraduate college students. The internal consistencies in the current study were .89 for scores on the perceived barriers subscale and .88 for scores the supports subscale.

### **Coping Efficacy**

The student's coping efficacy was assessed using Luzzo and McWhirter's (2001) Coping with Barriers Scale. This scale contains 28-items that assess respondent's degree of confidence in overcoming 21 potential educational barriers (e.g., "money problems") and 7 career-related barriers (e.g., "negative comments about my racial/ethnic background"). Responses are given on a 5-point scale ("1 = *not at all confident*" to "5 = *highly confident*") with higher scores reflecting a greater degree of confidence for overcoming educational and career-related barriers. The following prompt was added to the existing instructions for this measure: "assume you wanted to pursue a math or science-related major". Mean scores for each participant on the Coping with Barriers Scale were used in the current study.

Lopez and Yi (2006) found scores on this measure to correlate with scores on measures of barriers, supports, and career self-efficacy in SCCT consistent ways. More specifically, scores on this measure were found to negatively relate to scores on measures

of barriers and to positively relate to scores on measures of supports and self-efficacy.

Lindley (2005) reported an internal consistency of .96 for the Coping with Barriers Scale with a sample of undergraduate college students. The internal consistency was .93 for the total score on the Coping with Barriers Scale in the current study.

### **Math and Science Self-Efficacy**

Math and science self-efficacy was assessed with the Math/Science Self-Efficacy Scale (Smith and Fouad, 1999). The scale contains 6-items assessing one's confidence in completing various tasks in math/science domains likely to be encountered by college students (e.g., "earn an A in a math course" or "earn an A in a science course"). Responses are given on a 6-point scale ("1 = *very strongly disagree*" to "6 = *very strongly agree*") with higher scores reflecting greater math and science self-efficacy beliefs. Mean scores for each participant on the Math/Science Self-Efficacy Scale were used in the current study.

Consistent with SCCT hypotheses, Byars-Winston and Fouad (2008) found scores on this measure to positively correlate with scores on measures of outcome expectations and interests in math and science. Byars-Winston and Fouad (2008) reported an internal consistency of .85 with their sample of undergraduate college students. The internal consistency was also .85 for scores on the Math/Science Self-Efficacy Scale in the current study.

### **Outcome Expectations**

Outcome expectations were assessed using Smith and Fouad's (1999)

Math/Science Outcome Expectancies Scale. This scale contains 9-items assessing the extent to which participants agree with statements assessing the utility of math/science behavior (e.g., "if I learn math well, then I will be able to do lots of different types of careers"). Responses are given on a 6-point scale ("1 = *very strongly disagree*" to "6 = *very strongly agree*") with higher scores indicating more positive outcome expectations regarding math and science behaviors. Mean scores for each participant on the Math/Science Outcome Expectancies Scale were used in the current study.

Consistent with SCCT hypotheses, Byars-Winston and Fouad (2008) found scores on this measure to positively correlate with scores on measures of math/science self-efficacy, interests in math and science, and goal intentions. Byars-Winston and Fouad (2008) reported an internal consistency of .81 with their sample of undergraduate college students. The internal consistency was .85 for scores on the Math/Science Outcome Expectancies Scale in the current study.

### **Math/Science Interests**

Interests in math and/or science-related activities were assessed with the Math/Science Interest Scale (Smith & Fouad, 1999). This scale contains 17-items assessing the participant's level of interest in various math and science-related activities (e.g., "solving math puzzles" or "working in a science laboratory"). Responses are given on a 6-point scale ("1 = *very strongly disagree*" to "6 = *very strongly agree*") with higher scores reflecting greater interests in math and science-related activities. Mean scores for each participant on the Math/Science Interest Scale were used in the current study.

Consistent with SCCT hypotheses, Byars-Winston and Fouad (2008) found scores on this measure to positively correlate with scores on measures of math/science self-efficacy, outcome expectations, and goal intentions. Byars-Winston and Fouad (2008) reported an internal consistency of .91 with their sample of undergraduate college students. The internal consistency was .93 for scores on the Math/Science Interest Scale in the current study.

### **Choice Goals**

Choice goals were assessed using the Intentions-Goals Scale (Smith & Fouad, 1999). This scale contains 7-items assessing the extent to which participants intend to engage in various math and science-related activities in the future (e.g., "I intend to enter a career that will use math" or "I plan to take more science courses in college than will be required of me"). Responses are given on a 6-point scale ("1 = *very strongly disagree*" to "6 = *very strongly agree*") with higher scores indicating greater intentions to engage in math and science-related activities in the future. Mean scores for each participant on the Intentions-Goals Scale were used in the current study.

Consistent with SCCT hypotheses, Byars-Winston and Fouad (2008) found scores on this measure to positively correlate with scores on measures of math/science self-efficacy, outcome expectations, and interests in math and science-related activities. These findings are consistent with SCCT hypotheses. Byars-Winston and Fouad (2008) reported an internal consistency of .80 with their sample of undergraduate college students. The internal consistency was .85 for scores on the Intentions-Goals Scale in the

current study.

### **Preliminary Analyses**

When path models are estimated via the maximum likelihood (ML) method, a sample size to model parameters estimated ratio can be determined to inform a researcher of the needed sample size to demonstrate adequate power in a study. The rule states that the sample size to the number of model parameters ratio should be at least 5:1 or more ideally 10:1 or greater (Kline, 2011). The SCCT model with the greatest number of parameters in this study contained 22 parameters. As a result, a sample size of at least 220 (22 multiplied by 10) participants were sought for this study.

Once collected, all questionnaires were examined for missing values. A total of 251 questionnaires were initially collected for inclusion in this study. However, five were eliminated from subsequent analyses because they contained more than 5% ( $k = 5$ ) total missing items. Missing values on the remaining inventories were imputed based on mean scores for that individual, within that particular scale. Missing values on these questionnaires ranged from 1 ( $n = 17$ ) to five ( $n = 2$ ). Descriptive statistics were calculated including means, standard deviations, ranges, kurtosis, and skewness for all measures. Zero-order intercorrelations for all variables were calculated. In addition, potential source (i.e., Loyola University Chicago versus Governors State University), race/ethnicity, and sex differences on the variables included in this study were examined.

### **Main Analyses**

As previously mentioned, four different possible SCCT models were suggested

by existing research. Therefore, before addressing my main research question (whether and how coping efficacy mediates the relations between barriers and supports and math/science intentions) four possible mediator models were estimated and compared to ascertain their fit to the data. These models were estimated through a series of path analyses using the maximum likelihood method in version 8.80 of LISREL (Jöreskog & Sörbom, 2006). A fully mediated model for both supports and barriers to choice goals (Model A) was compared to three alternative models: Model B - a fully mediated model for supports to choice goals, but partially mediated for barriers to choice goals; Model C - a partially mediated model for supports to choice goals, but fully mediated for barriers to choice goals; and Model D - a partially mediated model for both supports and barriers to choice goals (Model D).

The degrees of freedom for Models A, B, C, D were 8, 7, 7, and 6, respectively. Model A required the estimation of fewer parameters compared to Models B, C, and D and therefore was the most parsimonious model of the four. In addition, Model A was nested within the three other models. Differences in chi-squares were examined between Model A (the most parsimonious model) and the other three models. The fit indices for the selected model were reported. These fit indices included the Maximum Likelihood Chi-Square along with two measures of absolute fit (Root Mean Square Error of Approximation and the Standardized Root Mean Residual) and two measures of relative fit (Comparative Fit Index and the Non-Normative Fit Index).

Next, individual hypotheses regarding the proposed mediated effects were



examined in the selected model. First, to address the main research question for the study, coping efficacy's potential mediating effect on the relation of support and barriers to math/science self-efficacy was examined. Second, the direct effect of supports on outcome expectations was assessed. Third, interest's potential mediating effect on the relation of math/science and outcome expectations to choice goals was evaluated. Fourth, the direct effect of math/science self-efficacy on outcome expectations was examined. Lastly, the total effect of each predictor in the model on choice goals was evaluated.

The alternative model of a moderating effect of coping efficacy on the relation of barriers to math/science self-efficacy was tested through a hierarchical multiple regression analysis. The intercorrelations between the demographic variables and barriers, coping efficacy, and math/science self-efficacy were examined to assess for any significant correlations before beginning the moderation analysis. The predictor (barriers) and the moderator (coping efficacy) were standardized as recommended by Frazier, Tix, and Barron (2004) to reduce potential problems with multicollinearity. Next, an interaction term was calculated by multiplying the standardized scores of barriers and coping efficacy. Then a hierarchical multiple regression was conducted in which potential covariates were entered in Step 1, scores on math/science self-efficacy were regressed on standardized scores of barriers and coping efficacy in Step 2, and then on the interaction term in Step 3. The amount of unique variance added by Step 3 was assessed for statistical significance using an *F*-test.

The simple slopes of the interaction were plotted at -1 and +1 standard deviations from the mean of coping efficacy to determine the particular form of the moderation effect. The slopes were examined to determine whether they differed from zero by using a t-test. Finally, the results were assessed to determine whether the initial hypothesis was correct (e.g., the negative relationship between barriers and self-efficacy beliefs would be weaker when coping efficacy is high than when it is low).

## CHAPTER FOUR

### RESULTS

This chapter presents the results of this dissertation. First, a summary of the descriptive statistics is presented. Second, the results of the path modeling analyses are discussed. Third, the results of the mediation analyses for coping efficacy are presented. Fourth, the remaining direct and indirect paths within the best fitting path model are summarized. Lastly, the results of the moderator analysis for coping efficacy are discussed.

As previously stated, the main purpose of this study was to test two plausible hypotheses about the role of coping efficacy in the development of math/science self-efficacy beliefs. The first hypothesis suggested that the effects of coping efficacy beliefs are largely mediational (i.e., that coping efficacy will mediate the relation between supports and barriers to math/science self-efficacy; see Figure 1). Prior to testing this hypothesis, four SCCT models suggested by existing research were estimated and compared to ascertain their fit to the data. The mediation hypothesis was tested within the model that best fit the data.

One model (Model A) hypothesized that the effects of supports and barriers on choice goals is fully mediated by coping efficacy, math/science self-efficacy, math/science outcome expectations, and math/science interests. This model was created by fixing paths 13 and 14 in Figure 1 (representing direct effects for supports and barriers

on choice goals) to zero, while freeing the other paths. The other three models represented different partial mediation possibilities. One of these alternative models (Model B) hypothesized that the effects of supports on choice goals was fully mediated, while the effects of barriers was partially mediated (i.e., there is also a direct effect of barriers on goals). This model was created by modifying Model A and freeing the path from barriers to goals (path 14 in Figure 1) to be estimated. The next partial mediation model (Model C) hypothesized that the effects of supports rather than barriers on goals is partially mediated. This model was created by freeing the path from supports to goals in Model A to be estimated (path 13 in Figure 1), while leaving the path from barriers to goals (path 14 in Figure 1) fixed at zero. Finally, Model D hypothesized that the effects of supports and barriers on goals are both partially mediated. Thus, paths 13 and 14 in Model A were freed to be estimated.

Finally, an alternative hypothesis about the interrelationships among barriers, coping efficacy, and math/science self-efficacy beliefs was tested. This hypothesis suggested that coping efficacy may function more as a moderator of the barriers to math/science self-efficacy relationship (i.e., that coping efficacy might buffer the negative effects of barriers on math/science self-efficacy beliefs). This hypothesis would be supported by finding that the negative relationship between barriers and self-efficacy beliefs would be weaker when coping efficacy is high than when it is low.

### **Descriptive Statistics**

The intercorrelations, means, standard deviations, ranges, skewness, kurtosis, and

internal consistency estimates for the seven SCCT variables are presented in Table 1. All the variables were significantly intercorrelated with the exception that barriers did not relate significantly to either math/science self-efficacy beliefs or interests. The finding of a nonsignificant correlation between barriers and interests is consistent with previous SCCT math/science-related examinations (e.g., Lent et al., 2005; Byars-Winston & Fouad, 2008). The finding of a nonsignificant correlation between barriers and math/science self-efficacy is also consistent with the findings of Byars-Winston and Fouad (2008). In addition, weak correlations (e.g., ranging from  $-.10$  to  $-.15$ ) between barriers and math/science self-efficacy have been found in several other SCCT math/science-related examinations (e.g., Lent, Brown, Schmidt, et al., 2003; Lent et al., 2005, Lent et al. 2011).

The sample reported encountering somewhat more supports ( $M = 3.72$ ) than barriers ( $M = 2.27$ ; potential range was 1-5 for both variables). The sample also expressed having higher math/science self-efficacy beliefs ( $M = 5.03$ ) in comparison to their math/science-related outcome expectations ( $M = 4.24$ ), interests ( $M = 3.72$ ), and choice goals ( $M = 3.78$ ; potential range was 1-6 for all four variables). The highest correlation in the inter-variable correlation matrix was between math/science-related interests and choice goals. This finding is consistent with previous SCCT math/science-related examinations (Byars-Winston & Fouad, 2008; Waller, 2006). Finally, the internal consistencies estimates were relatively high for scores on all seven scales (alpha's ranged from  $.85$  to  $.93$ ), suggesting that the bivariate and multivariate relationships among these

variables obtained in this study were not seriously attenuated.

Table 1. The Intercorrelations, Means, Standard Deviations, Ranges, Skewness, Kurtosis, and Internal Consistency Estimates of the SCCT Variables.

	1	2	3	4	5	6	7
1. Supports	1						
2. Barriers	-.59**	1					
3. CE	.48**	-.53**	1				
4. MSSE	.20**	-.10	.25**	1			
5. OE	.24**	-.13*	.13*	.33**	1		
6. Interests	.14*	-.09	.20**	.36**	.47**	1	
7. Choice Goals	.18**	-.21**	.19**	.33**	.47**	.72**	1
M	3.72	2.27	3.93	5.03	4.24	3.72	3.78
SD	.67	.64	.62	.91	.97	1.11	1.24
Minimum	1.43	1.00	1.64	1.00	1.00	1.35	1.00
Maximum	5.00	4.10	5.00	6.00	6.00	6.00	6.00
Potential Range	1-5	1-5	1-5	1-6	1-6	1-6	1-6
Skewness	-.71	.42	-.57	-1.48	-.29	.01	-.03
Kurtosis	.44	-.23	.32	2.94	-.20	-.70	-1.01
IC	.88	.89	.93	.85	.85	.93	.85

*Note.*  $N = 246$ . \*  $p < .05$ , two-tailed. \*\*  $p < .01$ , two-tailed. CE = Coping Efficacy; MSSE = Math/Science Self-Efficacy; OE = Outcome Expectations; IC = Internal Consistency.

Prior to moving forward with the primary analyses, potential source (i.e., Loyola University Chicago versus Governors State University), race/ethnicity, and sex differences on the variables included in this study were examined. The analyses for data source revealed that the participants from Loyola University Chicago (LUC;  $n = 156$ ) reported significantly more supports compared to the participants from Governors State University (GSU;  $n = 90$ ),  $M = 3.80$  ( $sd = .60$ ) versus  $3.58$  ( $sd = .75$ ) for LUC and GSU, respectively;  $t(244) = 2.60$ ,  $p = .010$ . Conversely, participants from LUC reported lower math/science-related choice goals ( $M = 3.59$ ;  $sd = 1.22$ ) when compared to the GSU

participants ( $M = 4.10$ ;  $sd = 1.20$ ),  $t(244) = 3.20$ ,  $p = .002$ . No significant differences were found on the other five SCCT variables.

Next, analyses were conducted to explore racial/ethnic differences. In order to have an adequate number of participants in both groups, the means of White participants were compared to those of a combined minority sample. The results revealed that White participants ( $n = 153$ ) reported encountering significantly more supports ( $M = 3.81$ ;  $sd = .61$ ), when compared to minority ( $n = 92$ ) participants ( $M = 3.57$ ;  $sd = .73$ ),  $t(243) = 2.70$ ,  $p = .008$ . Conversely, White participants reported fewer barriers ( $M = 2.20$ ;  $sd = .59$ ) in comparison to their minority counterparts ( $M = 2.39$ ;  $sd = .71$ ),  $t(243) = 2.27$ ,  $p = .024$ . Despite these differences in math/science supports and barriers, White participants reported significantly lower math/science interests ( $M = 3.51$ ;  $sd = 1.05$ ) compared to the minority participants ( $M = 4.07$ ;  $sd = 1.13$ ),  $t(243) = 3.97$ ,  $p = .001$ . They also reported lower math/science choice goals,  $M = 3.59$  ( $sd = 1.19$ ) versus  $M = 4.07$  ( $sd = 1.26$ ) for minorities,  $t(243) = 3.02$ ,  $p = .003$ . No significant differences were found on the other three variables.

Finally, potential gender differences on the seven SCCT variables were examined. Significant gender differences were found on the coping efficacy, math/science self-efficacy, and interests' scales. The female participants ( $n = 193$ ) reported lower coping efficacy beliefs ( $M = 3.89$ ;  $sd = .64$ ) in comparison to their male ( $n = 52$ ) counterparts ( $M = 4.08$ ;  $sd = .50$ ),  $t(243) = 2.05$ ,  $p = .041$ . They also reported lower math/science self-efficacy beliefs ( $M = 4.95$ ;  $sd = .95$ ) when compared to males ( $M$

= 5.32;  $sd = .70$ ),  $t(243) = 2.61$ ,  $p = .010$ , as well as fewer interests in math/science activities  $M = 3.59$  ( $sd = 1.11$ ) versus  $M = 4.17$  ( $sd = .99$ ),  $t(243) = 3.41$ ,  $p = .001$ . No other significant gender differences were found on the four remaining SCCT variables.

### **Path Analyses**

Next, a series of path analyses was conducted using the maximum likelihood method in version 8.80 of LISREL (Jöreskog & Sörbom, 2006). Four separate models were examined and compared in order to determine the best fitting model. The four compared models were: a fully mediated model for both supports and barriers to choice goals (Model A); a fully mediated model for supports to choice goals, but partially mediated for barriers to choice goals (Model B); a partially mediated model for supports to choice goals, but fully mediated for barriers to choice goals (Model C); and a partially mediated model for both supports and barriers to choice goals (Model D).

The separate path analyses revealed adequate to good fit for all four models (see Table 2). More specifically, the Root Mean Square Error of Approximation (RMSEA) value of .06 for Model's A and C suggested "reasonably close fit" to the data and the RMSEA value of less than .01 for Model's B and D indicated "close fit" (Browne and Cudeck, 1993). According to the criteria of Hu and Bentler (1998), all four models demonstrated acceptable fit to the data since the Standardized Root Mean Residual (SRMR) values were below .08 for all four models and the Comparative Fit Index (CFI) and Non-Normed Fit Index (NNFI) values were all greater than .95. Since all four models had adequate fit indices, especially Models B and D, analyses allowing for direct



comparison between the four models were conducted.

Table 2. Summary of Model Fit Indices.

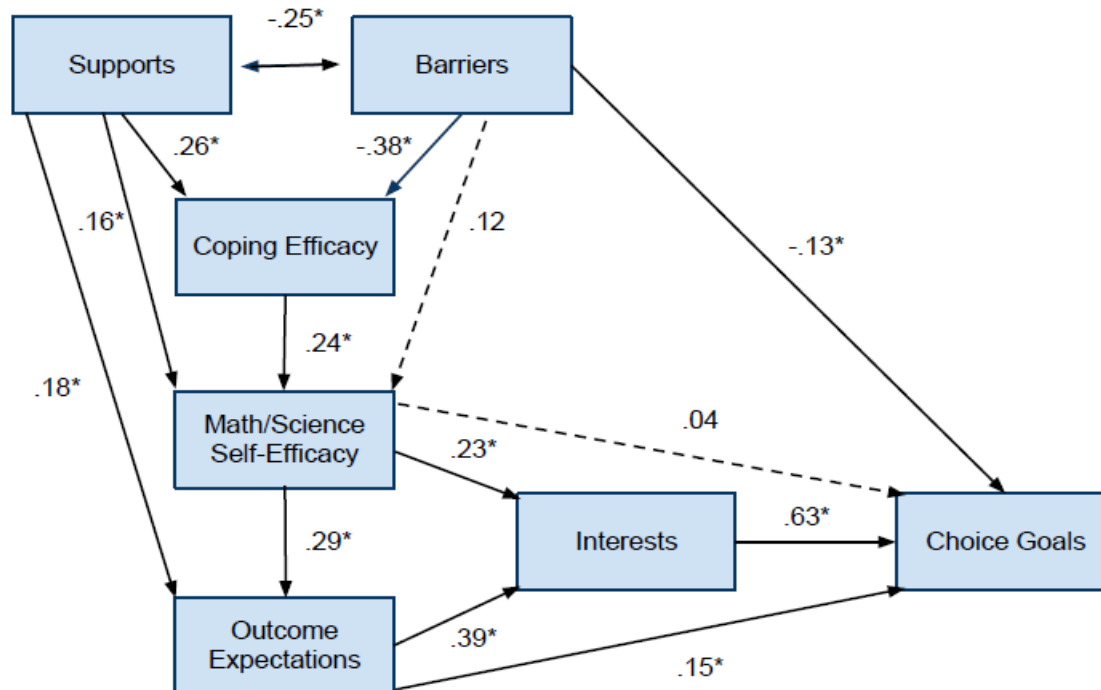
Model	Overall $\chi^2$	df	CFI	NNFI	SRMR	RMSEA	$\Delta \chi^2$ (df)
Model A	14.78	8	.99	.98	.03	.06	
Model B	5.67	7	1.00	1.01	.02	.00	A and B: 9.11 (1)
Model C	13.66	7	.99	.97	.03	.06	A and C: 1.12 (1)
Model D	4.95	6	1.00	1.01	.02	.00	A and D: 9.83 (2)

*Note.*  $N = 246$ . CFI = comparative fit index; NNFI = non-normative fit index; SRMR = standardized root mean residual; RMSEA = root mean square error of approximation.

First, differences in chi-square values were examined between the most parsimonious model (Model A) and the other three models. Model B fit the data significantly better than Model A,  $\Delta \chi^2 (1, N = 246) = 9.11$ . Model C did not fit the data significantly better than Model A,  $\Delta \chi^2 (1, N = 246) = 1.12$ . Finally, Model D also fit the data significantly better than Model A,  $\Delta \chi^2 (2, N = 246) = 9.83$ . In order to determine whether one of the two best fitting models (i.e., Models B and D) fit the data better than the other, a chi-square difference test between the two models was performed. Model D did not fit the data significantly better than Model B,  $\Delta \chi^2 (1, N = 246) = 0.72$ . Thus, while both Models B and D showed an equally good fit to the data, Model B was selected as the best fitting model since it was the more parsimonious model of the two models. This finding suggests that the relation of supports to choice goals is fully mediated, while

the relation of barriers to choice goals is partially mediated (i.e., barriers also have a direct relationship with choice goals). The standardized path coefficients for Model B are presented in Figure 3.

Figure 3. The Standardized Path Coefficients for Model B.



Note.  $N = 246$ . \*  $p < .05$ , two-tailed.

### Mediator Analyses for Coping Efficacy

Next, in order to address the main research question, coping efficacy's potential mediating effect on the relations of supports and barriers to math/science self-efficacy was examined. It was hypothesized that supports would relate to coping efficacy and math/science self-efficacy, but that the path to coping efficacy would be larger than the path to math/science self-efficacy. Similarly, it was hypothesized that barriers would

relate to coping efficacy and math/science self-efficacy, but that the path to coping efficacy would be larger than the path to math/science self-efficacy. Finally, it was also hypothesized that coping efficacy would relate to math/science self-efficacy.

The path from supports to coping efficacy was positive and statistically significant (standardized  $\beta = .26$ ) as was the path from supports to math/science self-efficacy (standardized  $\beta = .16$ ). In addition, the path to coping efficacy was larger than the path to math/science self-efficacy. Consistent with the hypothesis, the relation of supports to math/science self-efficacy was partially mediated by coping efficacy. Greater support was associated with higher coping efficacy, which in turn was associated with higher math/science self-efficacy beliefs. A Sobel test revealed that the indirect effect of supports on math/science self-efficacy via coping efficacy was statistically significant,  $Z = 2.47$ ,  $p = .014$ , unstandardized path coefficient = .083,  $SE = .034$ . Coping efficacy accounted for 28% of the influence of supports on math/science self-efficacy beliefs.

The path from barriers to coping efficacy was negative and statistically significant (standardized  $\beta = -.38$ ), however, the path from barriers to math/science self-efficacy was positive and nonsignificant (standardized  $\beta = .12$ ). Thus, contrary to the hypothesis, the relation of barriers to math/science self-efficacy was fully, not partially mediated by coping efficacy. A Sobel test revealed that the indirect effect of barriers on math/science self-efficacy via coping efficacy was statistically significant,  $Z = 2.79$ ,  $p = .005$ . The indirect effect of barriers on math/science self-efficacy via coping efficacy was negative and thus in the hypothesized direction, unstandardized path coefficient =  $-.128$ ,  $SE =$

.046. Lastly, consistent with the hypothesis, coping efficacy beliefs were found to significantly relate to math/science self-efficacy beliefs (standardized  $\beta = .24$ ). Higher coping efficacy beliefs were associated with higher math/science self-efficacy beliefs.

### **Direct and Indirect Paths**

Finally, all the paths in the full SCCT model were explored to see how well the full model used in this study fit past research on SCCT in the math and science domain. First, the direct effect of supports on outcome expectations was assessed. Past research suggested that supports would positively relate to outcome expectations. Second, interest's potential mediating effect on the relations of math/science self-efficacy and outcome expectations to choice goals was evaluated. Consistent with original SCCT hypotheses and subsequent research findings, it was hypothesized that math/science self-efficacy beliefs would relate to interests and choice goals, but that the path to interests would be larger than the path to choice goals. Similarly, it was hypothesized that outcome expectations would relate to interests and choice goals, but that the path to interests would be larger than the path to choice goals. In addition, it was hypothesized that interests would relate to choice goals. Third, the direct effect of math/science self-efficacy on outcome expectations was examined. It was hypothesized that math/science self-efficacy beliefs would positively relate to outcome expectations. Lastly, the total effect of each predictor in the model on choice goals was evaluated.

The path from supports to outcome expectations was positive and statistically significant (standardized  $\beta = .18$ ). Thus, consistent with prior SCCT research, greater

support was associated with higher outcome expectations. The path from math/science self-efficacy beliefs to interests was positive and significant (standardized  $\beta = .23$ ), however, the path from math/science self-efficacy to choice goals was nonsignificant (standardized  $\beta = .04$ ). Therefore, contrary to past research, the relation of math/science self-efficacy beliefs to choice goals was fully, not partially mediated by interests. A Sobel test revealed that the indirect effect of math/science self-efficacy on choice goals via interests (while controlling for the influence of outcome expectations) was statistically significant,  $Z = 5.25$ ,  $p < .001$ , unstandardized path coefficient = .292,  $SE = .056$ . Interests accounted for 71% of the influence of math/science self-efficacy beliefs on choice goals, which is highly consistent with past research on the primacy of interests in the prediction of choice goals in math and science.

The path from outcome expectations to interests was positive and statistically significant (standardized  $\beta = .39$ ) as was the path from outcome expectations to choice goals (standardized  $\beta = .15$ ). In addition, the path to interests was larger than the path to choice goals. Consistent with past research, the relation of outcome expectations to choice goals was partially mediated by interests. More positive outcome expectations were associated with greater math/science interests, which in turn were associated with higher math/science choice goals. A Sobel test revealed that the indirect effect of outcome expectations on choice goals via interests was statistically significant,  $Z = 5.96$ ,  $p < .001$ , unstandardized path coefficient = .312,  $SE = .052$ . Interests accounted for 63% of the influence of outcome expectations on choice goals. This finding is again

consistent with past research demonstrating the primacy of interests in predicting intentions to engage in math and science study.

Further confirming the primacy of interests, the path from interests to choice goals was positive and statistically significant (standardized  $\beta = .63$ ). Thus, consistent with past SCCT research, greater math/science-related interests corresponded to a greater intention to pursue math/science-related activities. The path from math/science self-efficacy beliefs to outcome expectations was positive and statistically significant (standardized  $\beta = .29$ ). Consequently, consistent with prior SCCT findings, stronger math/science self-efficacy beliefs were related to stronger outcome expectations. Finally, the standardized total effect of each variable on choice goals was: supports, .09; barriers, -.15; coping efficacy, .07; math/science self-efficacy, .31; outcome expectations, .40; and interests, .62. The SCCT variables included in the model accounted for approximately 56% of the total variance in choice goals.

### **Moderator Analyses for Coping Efficacy**

To examine the potential moderating effect of coping efficacy on the relation of barriers to math/science self-efficacy a hierarchical multiple regression analysis was conducted. The data were examined for potential covariates prior to the analysis, which seemed particularly important since gender differences were found on scores for the coping efficacy and math/science self-efficacy scales. Table 3 presents the correlations between the SCCT variables and the demographic variables.

Table 3. Intercorrelations between SCCT Variables involved in Moderator Analyses and Demographic Variables.

	Barriers	CE	MSSE
Data Source (LUC=1; GSU=2)	-.02	.03	-.04
Age	.06	.02	-.13*
Gender (Male=1; Female=2)	.11	-.14*	-.16*
White vs NonWhite (White=1; NonWhite=2)	.14*	.02	-.02
SES (Poor=1; Upper Class=5)	-.15*	.09	-.01
Mother's Education (1=Did not complete HS; 6=Doctoral)	.03	-.03	-.05
Father's Education (Same as above)	.02	.04	.06
Current Year	.07	.06	-.02
Educational Goal (Bachelor's=1; Doctoral=3)	.10	.00	.05
Current GPA	.09	-.05	.14*
HS GPA	-.00	-.03	.15*

*Note.* \*  $p < .05$ , two-tailed. LUC = Loyola University Chicago; GSU = Governors State University; CE = Coping Efficacy; MSSE = Math/Science Self-Efficacy.

An inspection of the correlations revealed that only gender was correlated with at least two of the three variables. Consequently, two moderator analyses were conducted — one with and one without gender entered at the first step as a covariate. The results revealed that these two sets of analyses were identical. Thus, only the “noncovariate” moderator results are presented.

To conduct the moderated multiple regression, raw scores obtained on the measures of barriers and coping efficacy were standardized before beginning the analysis in order to reduce multicollinearity (see Frazier et al., 2004). Next, a product term was created by multiplying the standardized values of barriers and coping efficacy for each participant. Finally, following the steps outlined by Frazier et al. (2004), the standardized barriers and coping efficacy values were entered first followed by the interaction of

barriers and coping efficacy. Table 4 presents the results of the moderation analysis.

Table 4. Moderating Effect of Coping Efficacy on the Relation of Barriers to Math Self-Efficacy.

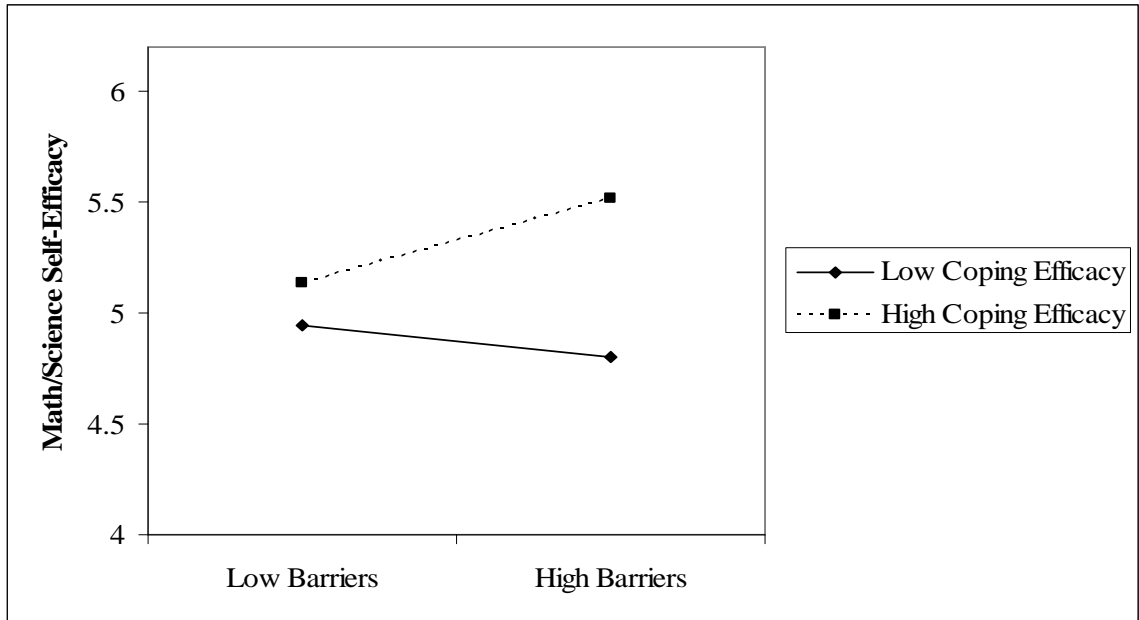
Step and Variable	<i>B</i>	SE <i>B</i>	95% CI	$\beta$	$R^2$	$\Delta R^2$	$\Delta F$
Step 1							
Barriers	.04	.067	-.09,.18	.05			
Coping Efficacy	.25	.067	.12,.38	.28**	.06	.06	8.32**
Step 2							
Barriers	.06	.066	-.07,.19	.06			
Coping Efficacy	.23	.067	.09,.36	.25**			
Barriers x Coping Efficacy	.13	.053	.03,.24	.16*	.08	.02	6.22*

*Note.*  $N = 245$ . \* $p < .05$ , two-tailed. \*\* $p < .01$ , two-tailed. CI = confidence interval.

A significant moderation effect was found for coping efficacy,  $\Delta F = 6.22$  ( $p = .013$ ). The interaction term between barriers and coping efficacy explained an additional 2% of the variance in math/science self-efficacy beyond the 6% explained by the combination of barriers and coping efficacy. Next, the particular form of the moderation effect occurring on math/self-efficacy was examined by plotting the simple slopes of the interaction separately for participants who scored one standard deviation or more above (high coping efficacy) versus those who scored one standard deviation or more below (low coping efficacy) the mean of the coping efficacy distribution (see Figure 4).



Figure 4. Moderation Plot of Barriers x Coping Efficacy on Math/Science Self-Efficacy.



*Note.*  $N = 245$ . The scores for coping efficacy are plotted at  $\pm 1$  SD from the mean.

An analysis of the simple slopes revealed that the plotted regression line for low coping efficacy was negative (standardized  $\beta = -.074$ ), but not significantly different from zero,  $t(245) = -0.88$ ,  $p = .378$ . However, the regression line for high coping efficacy was significantly different from zero,  $t(245) = 2.30$ ,  $p = .023$ , and positive (standardized  $\beta = .192$ ). Thus, although a moderator effect was observed, it was not in the form that was predicted. It had been initially hypothesized that coping efficacy would buffer the effects of barriers on math/science self-efficacy beliefs (that the negative relation between the two variables would be lower for those with high versus low coping efficacy). However, when controlling for the effects of coping efficacy a nonsignificant relationship was found between barriers and math/science self-efficacy (see Table 4). Thus, the inclusion of

coping efficacy did not reduce the negative impact of barriers on math/science self-efficacy beliefs, but rather produced a significant and positive relationship between barriers and math/science self-efficacy beliefs (i.e., more frequent barriers were associated with stronger self-efficacy beliefs when coping efficacy was strong). In summary, coping efficacy was found to buffer the effects of barriers on math/science self-efficacy beliefs, just not in the form as predicted. Instead of buffering a negative relation between barriers and math/science self-efficacy, high coping efficacy produced a positive relationship between the variables.

## CHAPTER FIVE

### DISCUSSION

Social Cognitive Career Theory's (SCCT) interest and choice models have been used in numerous studies to help explain how socio-cognitive math/science-related variables inform the formation of math/science-related interests and choices (Byars-Winston & Fouad, 2008; Byars-Winston et al., 2010; Gainor & Lent, 1998; Lent et al., 2001; Quimby et al., 2007; Waller, 2006). Research focused on how interests and choice goals in the STEM fields (science, technology, engineering, and mathematics) are formed, particularly among college students, will be essential for the future economic success of America. This research will inform nationwide efforts to increase the education of United States college students in math/science domains, which is a top national priority since international competition in the STEM fields continues to rise. The existing research on SCCT provides vital information on how to increase interests and choices within the STEM domain. However, a better understanding of how coping efficacy beliefs may relate to and interact with other SCCT variables to predict intentions to engage in math/science activities is needed. The main purpose of the current study was to test two plausible hypotheses about the role of coping efficacy in the development of math/science self-efficacy beliefs.

This chapter will begin with a discussion of the major findings of this dissertation. The findings on the descriptive statistics, path analyses, mediation analyses

for coping efficacy, the other direct and indirect effects in the selected model, and finally the moderation analysis for coping efficacy will be discussed. Next, the counseling implications derived from this research will be outlined. Finally, the limitations of this research along with the implications for future research will be presented.

### **Descriptive Statistics**

Results from this study revealed a moderate correlation between coping efficacy and math/science self-efficacy ( $r = .25$ ). This result is consistent with previous SCCT examinations, which have also found a moderate relation between coping efficacy and task self-efficacy (e.g., Byars-Winston and Fouad, 2008,  $r = .42$ ; Lopez and Yi, 2006,  $r = .43$ ). As stated earlier, a latent variable of efficacy beliefs with task self-efficacy and coping efficacy serving as indicators has been used in prior SCCT investigations (Lent et al., 2001; Lent, Brown, Schmidt, et al., 2003; Lent et al., 2005; Lent et al., 2011). The moderate relation between coping efficacy and math/science self-efficacy found in this study suggests that these two constructs, while related, are measuring unique things. Thus, coping efficacy beliefs warrant examination as a unique construct separate from task self-efficacy beliefs in future SCCT studies.

The sample indicated receiving more support (compared to barriers) for pursuing a math/science-related major. This is a consistent finding in SCCT math/science-related investigations (e.g., Fouad et al., 2010; Lent et al., 2001; Lent et al., 2005; Lent et al., 2011). In addition, the minority participants in this study indicated experiencing significantly more barriers and fewer supports when compared to the White participants. This is also a consistent finding in SCCT investigations (e.g., Luzzo & McWhirter, 2001;

Quimby et al., 2007). Despite the perception of greater barriers and fewer supports, the minority participants indicated greater math/science interests and choice goals when compared to the White participants. Thus, the minority participants in this sample had intentions to pursue math/science activities despite the expectation of encountering significant barriers and little support while pursuing activities in these domains. This finding may indicate that efforts to increase STEM-related interests and choices within minority populations may be starting to take effect in the general undergraduate college population. Continued effort in this area may help promote interests and intentions to pursue STEM fields for minority populations despite the likelihood that they are still going to encounter significant barriers and few supports in these fields.

Gender differences were found on the two efficacy variables (i.e., coping and math/science) as well as on math/science-related interests. More specifically, women reported lower efficacy beliefs and fewer math/science interests when compared to their male counterparts. Gender differences on self-efficacy beliefs and interests in the STEM fields have led to suggestions that the facilitation of self-efficacy beliefs (e.g., through early successful experiences with math/science-related activities) will have an important role in increasing the representation of women in the STEM fields (Hackett & Betz, 1981; Hackett & Byars, 1996; Betz & Hackett, 2006). Continued findings of gender differences on self-efficacy beliefs and interests in the STEM fields for the general undergraduate college population may suggest that these efforts have not been implemented adequately. In particular, it is likely that gender socialization stereotypes

for math/science are still very prominent in the US culture.

### **Path Analyses**

The results of this study revealed that all four of the models concerning the mediating role of coping efficacy on the relation between supports and barriers on choice goals had adequate to good fit to the data. However, direct comparisons among the four models revealed that two of the models had better fit to the data. The more complicated model (of the two better fitting models) did not fit the data better than the more parsimonious model. Thus, based on fit and parsimony, the model specifying that the relation of supports to choice goals is fully mediated, while the relation of barriers to choice goals is partially mediated (i.e., barriers also have a direct relationship with choice goals) was selected as the best model for this data. This finding is consistent with the results of Lent et al. (2005) who also found that a fully mediated relation for supports to choice goals, but a partially mediated relation for barriers to choice goals was the best fitting model for their sample of engineering majors. The findings from this dissertation were also consistent with Bandura's hypothesis that contextual influences affect choice goals both directly and indirectly through self-efficacy beliefs. However, the indirect influence of contextual influences on choice goals occurred through both self-efficacy beliefs as well coping efficacy beliefs in this study.

### **Mediation Analyses for Coping Efficacy**

One of the two main hypotheses for this study was that coping efficacy would partially mediate the relations of supports and barriers to math/science efficacy. This

hypothesis was based on suggestions in the SCCT literature as well as on the results of a recent SCCT math/science-related investigation (Byars-Winston & Fouad, 2008).

Results of the current study revealed mixed support for this hypothesis. More specifically, coping efficacy was found to mediate both the relation of supports to math/science self-efficacy as well as the relation of barriers to math/science self-efficacy. However, the relation of barriers to math/science self-efficacy was fully, not partially mediated by coping efficacy beliefs. A significant relation between barriers and math/science self-efficacy was not found in the current study. The results for the indirect effects of both supports and barriers on math/science self-efficacy via coping efficacy were in the hypothesized direction.

Supports were found to positively influence coping efficacy beliefs, which in turn, were found to positively influence math/science self-efficacy beliefs. Overall, coping efficacy accounted for more than a quarter ( $r^2 = 28\%$ ) of the influence of supports on math/science self-efficacy. This finding has several implications for career counseling which will be discussed later in this chapter. Barriers were found to negatively influence coping efficacy beliefs, which in turn, were found to negatively influence math/science self-efficacy beliefs. Interestingly, despite the finding of a negative and significant indirect effect of barriers on math/science self-efficacy via coping efficacy, the direct effect of barriers on math/science self-efficacy while coping efficacy was included in the model was positive, but nonsignificant.

### **Direct and Indirect Paths**

The current study hypothesized that supports would directly influence outcome expectations. More specifically, that greater support would be associated with more positive outcome expectations for engaging in math and science-related behaviors. The results revealed that supports were found to directly and positively influence outcome expectations. The finding of a direct path from perceived supports to outcome expectations, while not part of original SCCT hypotheses (Lent et al., 1994), is consistent with the results of a recent meta-analytic investigation of existing SCCT studies (Sheu et al., 2010). As a result, researchers using the SCCT model should strongly consider freeing a direct path from supports to outcome expectations in future examinations.

The current study also hypothesized that the effect of math/science self-efficacy and outcome expectations on choice goals would be partially mediated by interests. This hypothesis was based on original SCCT hypotheses (Lent et al., 1994). The findings revealed mixed support for this hypothesis. More specifically, interests were found to mediate the relation of math/science self-efficacy to choice goals as well as mediate the relation of outcome expectations to choice goals; however, the relation of math/science self-efficacy to choice goals was fully, not partially mediated by interests. As a result, the influence of math-self efficacy beliefs on choice goals for this sample was occurring only through their math/science-related interests.

Math/science self-efficacy beliefs were found to positively influence interests, which in turn, were found to positively influence choice goals. Overall, interests



accounted for nearly seventy-five percent ( $r^2 = 71\%$ ) of the influence of math/science self-efficacy on choice goals. In addition, outcome expectations were found to positively influence interests. These interests, in turn, were found to positively influence choice goals. Interests accounted for more than half ( $r^2 = 63\%$ ) of the influence of outcome expectations on choice goals.

Finally, the current study hypothesized that math/science self-efficacy beliefs would directly inform outcome expectations. That is, the students would perceive more positive outcomes when they had stronger math/science efficacy beliefs. The results revealed that math/science self-efficacy beliefs did positively relate to outcome expectations. Consequently, higher math/science self-efficacy beliefs were associated with more positive outcome expectations for engaging in math and science-related behaviors. This finding is also consistent with original SCCT hypotheses (Lent et al., 1994).

### **Moderation Analyses for Coping Efficacy**

The second main hypothesis for this study suggested that coping efficacy may moderate the relation of barriers to math/science self-efficacy (i.e., that coping efficacy might buffer the negative effects of barriers on math/science self-efficacy beliefs). This hypothesis was based on suggestions in the SCCT literature and in particular, Bandura's (1997) assertion that the strength of one's coping efficacy may determine how barriers impact self-efficacy beliefs. The hypothesis for this moderated model was that the negative relationship between barriers and self-efficacy beliefs would be weaker when

coping efficacy is high than when it is low.

The results of the moderation analyses confirmed that coping efficacy did moderate the relation of barriers on math/science self-efficacy. While the form of the moderation effect did not turn out as expected, the finding demonstrated coping efficacy's buffering effect on the relationship between barriers and math/science self-efficacy. More specifically, the results of the moderator analysis suggested that when coping efficacy beliefs were high, coping efficacy produced a positive relationship between barriers and math/science self-efficacy beliefs. When coping efficacy beliefs were low, barriers were not found to have a significant relationship with math/science self-efficacy. However, the nonsignificant results were in the expected direction. That is, students who were low in coping efficacy experienced a decrease in their math/science self-efficacy beliefs with the perception of greater barriers.

This finding may help to explain some of the inconsistent meditation results described above. In particular, why there was a negative and significant indirect effect for barriers on math/science self-efficacy via coping yet there was also a positive (but nonsignificant) direct effect for barriers on math/science self-efficacy in the full model. For example, this finding may suggest that there were competing effects for participants in the sample who had a negative relation between their experience of barriers and math/science self-efficacy beliefs versus those who had a positive relation between these two variables. Consequently, the negative relation for those low in coping efficacy and the positive relation for those high in coping efficacy may have resulted in a near null

relationship between barriers and math/science self-efficacy in the full sample.

The results of this dissertation suggest that a differential effect of perceived barriers on math/science self-efficacy is occurring within two subsets of the sample. For individuals low in coping efficacy, barriers have a small negative effect on their math/science self-efficacy beliefs. As a result, the perception of greater barriers results in lower math/science self-efficacy beliefs. For individuals high in coping efficacy, barriers have a positive effect on their math/science self-efficacy beliefs. Thus, individuals high in coping may actually benefit from encountering barriers—that the success in overcoming the challenges associated with these barriers may somehow translate into greater math/science self-efficacy beliefs. This could be an example of resilient individuals encountering something negative (e.g., barriers) and somehow turning this negative into something positive (e.g., raised self-efficacy beliefs).

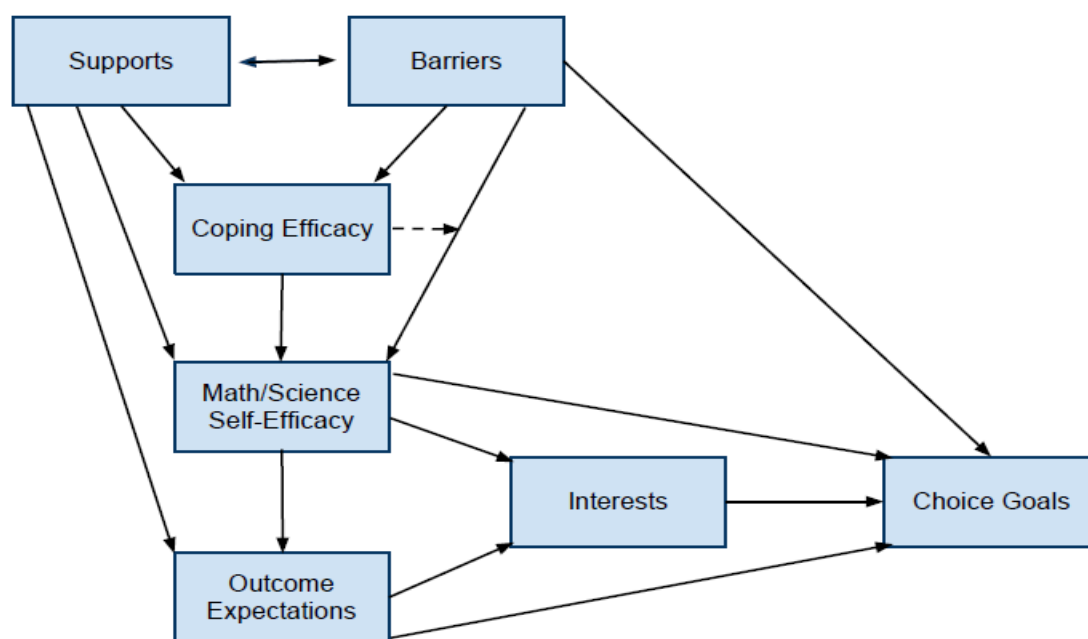
In summary, the relations between barriers, coping efficacy, and math/science self-efficacy were more complex than first hypothesized. Significant results were found when coping efficacy was considered as both a mediator and a moderator in the SCCT model. This result is not entirely surprising since coping is often conceptualized as either a mediator or a moderator in research, depending on the study and the conceptualization of coping (Bennett, 2000). For instance, some researchers study coping as a mechanism that is initiated after an obstacle is encountered. In this situation coping would be conceptualized as a mediator since encountering the obstacle launches a coping response, which then influences the outcome variable. However, coping is also often

conceptualized as a moderator since it can explain weak versus strong stressor-outcome variable relationships. In these situations high or low coping helps describe situations when the relationship between a stressor variable and an outcome variable are different or inconsistent. Overall, the answer to whether coping efficacy should be conceptualized as a mediator or moderator greatly depends on the SCCT model and the question one is trying to answer.

In general, the moderating relationship between barriers, coping efficacy, and math/science self-efficacy has significant implications for SCCT. The findings from this study suggest that coping efficacy beliefs have an important role in buffering the negative effects of barriers on math/science self-efficacy beliefs. More specifically, the possession of high coping efficacy beliefs help to establish a positive relationship between barriers and math/science self-efficacy beliefs.

The finding of coping efficacy to moderate the relation of barriers to math/science self-efficacy also coincides with the finding of coping efficacy to partially mediate the relation of supports to math/science self-efficacy. From a theoretical perspective, facilitating more support helps to increase coping efficacy, which in turn, helps to increase math/science self-efficacy beliefs. In addition, the positive influence of supports on coping efficacy also helps to assist in buffering the adverse effect of barriers on math/science self-efficacy (see Figure 5).

Figure 5. Proposed Theoretical Model.



### Counseling Implications

The results from this dissertation have several implications for clinical work. Researchers have suggested using specific counseling strategies aimed at raising self-efficacy beliefs through support building (Lent, Brown, Schmidt et al., 2003). Results from this study suggest that support building does have both a direct and indirect influence on self-efficacy beliefs. More specifically, support building results in greater coping efficacy beliefs, which in turn positively influence math/science self-efficacy beliefs. In addition, supports can directly influence math/science self-efficacy beliefs with greater support resulting in higher math/self-efficacy beliefs. Consequently, support building should be a focus of career counseling when attempting to increase math/science self-efficacy beliefs.

Support building can also influence outcome expectations, interests, and choice goals through the relation of supports with math/science self-efficacy beliefs. For instance, support building can directly increase math/science self-efficacy beliefs, which in turn, can help create more positive outcome expectations. More positive outcome expectations can positively influence both math/science interests and choice goals. In addition, more positive self-efficacy beliefs directly result in greater interests in math/science-related activities and choice goals. Finally, the results of this dissertation suggest that support building can have direct effect on outcome expectations. Thus, increasing support can result in more positive outcome expectations for math and science-related behaviors. As mentioned above, these positive outcome expectations positively influence both math/science interests and choice goals.

Previous researchers have also suggested that support building can help offset the negative influence of barriers on SCCT-related variables (Lent et al., 2005). The results from this study are consistent this hypothesis. More specifically, increasing supports seem particularly important when attempting to raise coping efficacy beliefs and counter the negative impact of barriers on math/science self-efficacy beliefs. Support building in career counseling may serve to positively influence coping efficacy beliefs, which then can help to buffer the negative impact of barriers on math/science self-efficacy beliefs. The results of this study also suggest that if coping efficacy beliefs are raised enough, when one perceives significant barriers it may even result in higher math/science self-efficacy beliefs for them (i.e., barriers being turned in something

positive).

Perceived barriers were also found to have a direct relation to choice goals with the perception of greater barriers resulting in lower math/science-related choice goals. Therefore, the direct impact of barriers on math/science-related choice goals should be addressed in career counseling. For instance, the anticipation of being discriminated against in a math/science-related domain may directly influence a client's decision to pursue a career in such a domain. Therefore, counseling interventions geared towards reducing or at least addressing one's perceptions of barriers to be encountered in math and science-related domains could alleviate some of the negative influence barriers can have on choice goals specific to these domains.

Results from this study also suggest that increasing self-efficacy beliefs and outcome expectations specific to math and science can create greater interest in math and science-related activities, which in turn will increase the likelihood of engaging in math and science-related behaviors. Therefore, increasing math/science self-efficacy and outcome expectations should be a focal point in counseling when attempting to raise interests in math/science-related activities and eventually increase the pursuit of such activities. In addition, math/science self-efficacy beliefs were found to directly inform outcome expectations. Therefore, increasing math/science self-efficacy beliefs are one way to raise outcome expectations for engaging in math/science behaviors.

### **Limitations and Implications for Future Research**

Several limitations for this research should be noted. First, the participants in

the current study reported the perception of greater supports than barriers to be encountered in their pursuit of math/science-related domains. Examining a sample with the perception of greater barriers than supports to be encountered in STEM-related domains may provide a better understanding of how a more negatively perceived environment affects the pursuit of these fields. Replicating the study with a sample comprising of individuals from lower socio-economic statuses, minority cultures, nontraditional college-aged populations, and those with greater overall challenges may provide greater clarity on how to best assist individuals coming from disadvantaged positions. These individuals may be more likely to possess high coping efficacy beliefs in addition to the perception of high barriers and low supports. Therefore, such a population may also provide a greater understanding of how the perception of greater barriers would be associated with higher self-efficacy beliefs in a resilient population.

Second, the current study did not separate contextual influences into categories of distal or proximal. The Lent et al. (2001) domain-specific (math/science) perceived barrier and support measure used in this study assesses the perception of more proximal contextual influences (e.g., "have trouble getting assistance from teachers and teaching assistants") compared to distal contextual influences (e.g., childhood parental support). Thus, the influence of distal supports and barriers were not specifically addressed in this research.

Future research on the influence of distal contextual influences on the SCCT interest and choice models may provide additional clarity on how math/science-related



interests and choices are formed. In particular, the impact of distal contextual influences on the formation of coping efficacy beliefs would be particularly useful. Currently, no SCCT research exists that assesses how coping efficacy beliefs are formed. Assessing the role of distal contextual influences on the formation of coping efficacy beliefs may help to explain the moderating role of high coping efficacy on the positive relation of barriers to math/science self-efficacy. For example, does encountering numerous barriers and experiencing success in coping with these barriers help to form robust coping efficacy beliefs over time? How do these coping efficacy beliefs relate to the formation of task-specific self-efficacy beliefs? What is the role of supports in the formation of coping efficacy beliefs? Answers to these questions may help us better understand how some individuals succeed despite encountering few supports, many barriers, and limited exposure to task-specific self-efficacy belief building experiences.

The third limitation of this study was that it was a cross-sectional study. A longitudinal study involving the variables assessed would contribute more to the current SCCT literature. In particular, several inferences were drawn when conducting the mediation analyses which would have been better examined in a longitudinal study. Research examining distal and proximal contextual influences on the SCCT interest and choice model over time would contribute greatly to the current SCCT research. Lastly, the current study did not examine the full SCCT model. Distal contextual influences, learning experiences, and SCCT's performance model were all excluded from the study. Replication of this research, within the context of the full SCCT model, would have

contributed more to the SCCT literature. In particular, specifically studying the role of coping efficacy in the SCCT performance model with resilient populations could be informative to the existing SCCT research.

Despite these limitations, the current study does help to contribute to the existing SCCT research on the relations between barriers, supports, coping efficacy, math/science self-efficacy, outcome expectations, math/science interests, and choice goals. Furthermore, it provides some clarity on how one's perceptions of their environment influences several important career outcomes specific to the math and science-related domains. As previously mentioned, the current SCCT research seems to show a bias towards examining the hindering impact of barriers on SCCT-related variables. The results of this dissertation suggest that supports have a vital role in the SCCT model and may warrant more attention moving forward.

Finally, the results from this study indicate that coping efficacy is an important variable to examine, separate from task-self efficacy, when conducting research using the SCCT model. Coping efficacy was found to have a role in how both supports and barriers influence other SCCT variables. The mediating role of coping efficacy on the relation between supports and math/science self-efficacy is straightforward. That is, increasing support will result in higher coping efficacy beliefs, which in turn result in greater math/science self-efficacy beliefs. The role of coping efficacy on the relation between barriers and math/science self-efficacy is less straightforward. However, the finding of coping efficacy to moderate the relation of barriers to math/science self-

efficacy beliefs was a key finding. In particular, finding high coping efficacy beliefs to be associated with an increase in math/science self-efficacy beliefs with the perception of greater barriers was significant.

The differential effects for high versus low coping may help to explain some of the previous SCCT findings of a weak relation between perceived barriers and math/science self-efficacy (e.g., Byars-Winston & Fouad, 2008, Lent, Brown, Schmidt, et al., 2003; Lent et al., 2005, Lent et al. 2011). When samples with a wide range of participants are selected, some individuals in that sample will possess high coping efficacy beliefs whereas others will possess low coping efficacy beliefs. Since the possession of high coping efficacy beliefs is associated with a positive relation between barriers and math/science efficacy and the possession of low coping efficacy beliefs is associated with a negative relation between these variables, the competing effects may cancel one another out. As a result, the total effect of barriers on math/science self-efficacy will appear weak or nonsignificant. Consequently, it is vital to consider coping efficacy beliefs when attempting to get an accurate assessment of the relation between barriers and math/science efficacy beliefs. Specifically seeking out samples that are either low in coping efficacy or high in coping efficacy could help to clarify the differential effect of barriers on math/science self-efficacy under these conditions.

Research examining the moderating role of coping efficacy on the relation of barriers to other math/science-related variables (i.e., other than math/science self-efficacy) may also be warranted. For instance, Lindley (2005) investigated the relations

of barriers, coping efficacy, and outcome expectations across Holland themes and found similar results to this study in the Investigative theme. More specifically, the study revealed barriers positively related to outcome expectations for the undergraduate women in the study, however, a nonsignificant and negative relation was found between barriers and outcome expectations for the men. Females in the study perceived significantly more barriers and reported higher coping efficacy beliefs compared to the males in that particular study. Researchers using the SCCT model (e.g., Flores & O'Brien, 2002; Kenny et al., 2003; McWhirter et al., 1998; Wettersten et al., 2005) have also found inconsistent effects of barriers on other outcome variables such as school engagement and career attitudes. The investigation of barriers on these outcome variables in conditions of high versus low coping could potentially reveal similar effects.

APPENDIX A  
IRB APPROVAL LETTERS



## OFFICE OF RESEARCH SERVICES

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Monday, December 19, 2011

Dear Matthew Abrams,

On Monday, December 19, 2011 the Loyola University Chicago Institutional Review Board (IRB) reviewed your application for confirmation of exemption titled "**The relation of supports and barriers to the math/science academic and career choice goals of undergraduate college students**". Based on the information you provided, the IRB determined that this human subject research project is exempt from the IRB oversight requirements according to 45 CFR 46.101.

If you make changes to the research procedures that could affect the exempt status of this project, your proposal should be reevaluated by the IRB to confirm it is still exempt from the IRB oversight requirements. To modify this proposal, please submit an Amendment/Project Update Application using the online CAP program. Complete details about the application process and your responsibilities can be found on the [Office for Research Services web site](#).

Please notify the IRB of completion of this research and/or departure from the Loyola University Chicago by submitting a Project Closure Application. In all correspondence with the IRB regarding this project, please refer to IRB project number #642 or IRB application number #747.

Best wishes for your research,

Raymond H. Dye, Jr., Ph.D.  
Chairperson, Institutional Review Board

**Office of the Provost****Memo**

**To:** Dr. Al Tuskenis - Matthew Abrams

**From:** **Dr. David Rhea and Dr. Dale Schuit – IRB Co-Chairs**

**CC:** David Deeds

**Date:** January 25, 2012

**Re:** **The relation of supports and barriers to the math/science academic and career choice goals of undergraduate college students.**

**Project Number:** #12-01-08

The Institutional Review Board at Governors State University has granted exempt approval for your project. You may begin your research.

Please be advised that if you make any substantive changes in your research protocols, you must inform the IRB and have the new protocols approved. Please refer to your GSU project number when communicating with us about this research.

APPENDIX B  
CONSENT FORM



## **CONSENT TO PARTICIPATE IN RESEARCH**

**Project Title:** The relation of supports and barriers to the math/science academic and career choice goals of undergraduate college students

**Researcher(s):** Matthew Abrams

**Faculty Sponsor:** Dr. Steven Brown

### **Introduction:**

You are being asked to take part in a research study being conducted by Matthew Abrams for a dissertation under the supervision of Dr. Steven Brown in the Department of Counseling Psychology at Loyola University of Chicago.

You are being asked to participate because you are enrolled in an undergraduate course within the School of Education. To participate in this study you must be at least eighteen years of age. Therefore, if you are under the age of eighteen you are ineligible to participate in this study. The questionnaires that you will complete are only available in English. Therefore, anyone who is not fluent in English is also ineligible to participate in this study.

**Please read this form carefully and ask any questions you may have before deciding whether to participate in the study.**

### **Purpose:**

The purpose of this study is examine how perceived supports, barriers, and other socio-cognitive variables impact undergraduate college student's goals to engage in math and science-related tasks in their future.

### **Procedures:**

If you agree to be in the study, you will be asked to complete a set of questionnaires inquiring about your demographic information and a range of beliefs related to your academic and career development. It should take you approximately 15-20 minutes to complete the survey. Please deposit the completed survey inside the large collection envelope.

### **Risks/Benefits:**

There are no foreseeable risks involved in participating in this research beyond those experienced in everyday life. If at any time you feel uncomfortable about completing the questionnaire you are able to withdraw from this study without penalty. While there are no direct benefits to you for participating, the information gathered will contribute to research in career development and subsequently help career counselors provide better

assistance to individuals who are experiencing challenges related to their career development.

**Confidentiality:**

Please do not indicate your name or student ID anywhere on the questionnaire. Information obtained as a result of this survey will be kept confidential. There is no way a participant can be identified in this survey. All data will be kept in a locked cabinet and will be destroyed 5 years after the completion of the study. Only the listed researcher, faculty sponsor, and individual administering the survey will have access to the data.

**Voluntary Participation:**

Participation in this study is voluntary. If you do not want to be in this study, you do not have to participate. Even if you decide to participate, you are free not to answer any question or to withdraw from participation at any time without penalty. The decision not to participate in the study or to withdraw at any time will have no bearing on the course you are completing and will not impact your performance or final grade.

**Contacts and Questions:**

If you have questions about this research project, feel free to contact Matthew Abrams at mabrams@luc.edu or the faculty sponsor Dr. Steven Brown at sbrown@luc.edu. If you have questions about your rights as a research participant, you may contact the Loyola University Office of Research Services at (773) 508-2689.

**Statement of Consent:**

Your return of the questionnaire will indicate consent for an informed participation. If you decide not to participate in this study please return the blank survey.

APPENDIX C  
DEMOGRAPHIC QUESTIONNAIRE

### Demographics

1. Age: \_\_\_\_\_
2. Gender : \_\_\_\_\_ Male \_\_\_\_\_ Female
3. Which of the following best describes your racial/ethnic background:
 

_____ African American/Black:	_____ American Indian/Alaska Native
_____ Asian American/Pacific Islander	_____ Hispanic American/Latino/a
_____ White/Caucasian	_____ Multiracial
_____ Other	
4. Which category best describes your family of origin's economic status?
 

_____ poor	_____ lower-middle class	_____ middle class
_____ upper-middle class	_____ upper class	
5. What is your mother's/maternal guardian's highest level of education?
 

_____ Did Not Complete High School	_____ GED
_____ High School Diploma	_____ Associate's Degree
_____ Bachelor's Degree	_____ Master's Degree
_____ Doctoral Degree	
6. What is your father's/paternal guardian's highest level of education?
 

_____ Did Not Complete High School	_____ GED
_____ High School Diploma	_____ Associate's Degree
_____ Bachelor's Degree	_____ Master's Degree
_____ Doctoral Degree	
7. What is your current length of time in college?
 

_____ 1 <sup>st</sup> year	_____ 2 <sup>nd</sup> year	_____ 3 <sup>rd</sup> year
_____ 4 <sup>th</sup> year	_____ Beyond 4 <sup>th</sup> year	
8. What is your educational goal?
 

_____ Bachelor's Degree	_____ Master's Degree	_____ Doctoral Degree
-------------------------	-----------------------	-----------------------

9. What is your current estimated GPA? \_\_\_\_\_
10. What was your final estimated high-school GPA? \_\_\_\_\_
11. What is your current or intended major?  
\_\_\_\_\_

APPENDIX D

MATH/SCIENCE BARRIER AND SUPPORT MEASURE

Lent et al. (2001)

**Instructions:** People face a variety of factors that may support or hinder their college and career plans. We are interested in knowing about the situations, either helpful or unhelpful, you believe you might experience in relation to one particular choice option: the decision to pursue an academic major involving a heavy concentration of math or science (e.g., mathematics, engineering, physics, computer science).

We realize that you may or may not actually intend to declare such a major. But for the purposes of the questions in this part, ***assume that you wanted to select a math or science-related college major.*** How likely would you be to experience each of the following situations? **Circle the number that best reflects how likely you believe you would be to encounter each situation.**

	Not at all Likely 1	A Little Likely 2	Moderately Likely 3	Quite Likely 4	Extremely Likely 5
<b>If you were to major in a math or science-related field, how likely would you be to...</b>					
1. Feel accepted by your classmates	1	2	3	4	5
2. Have access to a "role model" in this field (i.e., someone you can look up to and learn from by observing)	1	2	3	4	5
3. Be able to afford the extra cost of advanced training in this field	1	2	3	4	5
4. Feel support for this decision from important people in your life (e.g., teachers)	1	2	3	4	5
5. Feel that there are people "like you" in this field	1	2	3	4	5
6. Get helpful assistance from a tutor, if you felt you needed such help	1	2	3	4	5
7. Get encouragement from your friends for pursuing this major	1	2	3	4	5
8. Get helpful assistance from your advisor	1	2	3	4	5
9. Be able to receive enough money through financial aid or other sources to allow you to pursue this major	1	2	3	4	5
10. Feel that your family members support this decision	1	2	3	4	5
11. Have friends or family who would help you with math or science problems	1	2	3	4	5

12. Have enough money saved up to be able to complete your education in this field	1	2	3	4	5
13. Feel that close friends or relatives would be proud of you for making this decision	1	2	3	4	5
	<b>Not at all Likely 1</b>	<b>A Little Likely 2</b>	<b>Moderately Likely 3</b>	<b>Quite Likely 4</b>	<b>Extremely Likely 5</b>

**If you were to major in a math or science-related field, how likely would you be to...**

14. Have access to a "mentor" who could offer you advice and encouragement	1	2	3	4	5
15. Have enough financial support from your family to pursue this academic major	1	2	3	4	5
16. Receive negative comments or discouragement about your major from family members	1	2	3	4	5
17. Worry that such a career path would require too much time or schooling	1	2	3	4	5
18. Feel that you don't fit in socially with other students in this major	1	2	3	4	5
19. Receive unfair treatment because of your racial or ethnic group	1	2	3	4	5
20. Have professors or teaching assistants who are difficult to understand	1	2	3	4	5
21. Not have enough time for social or leisure activities	1	2	3	4	5
22. Feel pressure from your family to get out of college and begin making money	1	2	3	4	5
23. Receive unfair treatment because of your gender	1	2	3	4	5
24. Have trouble getting assistance from teachers and teaching assistants	1	2	3	4	5
25. Feel that demands of pursuing such a field would get in the way of family responsibilities	1	2	3	4	5
26. Experience financial strain, especially if this career path required additional training	1	2	3	4	5



27. Receive negative comments or discouragement about your major from friends	1	2	3	4	5
28. Feel a lack of support from professors or your advisor	1	2	3	4	5
29. Feel that you are different from others in this major because of your racial or ethnic group	1	2	3	4	5
	<b>Not at all Likely 1</b>	<b>A Little Likely 2</b>	<b>Moderately Likely 3</b>	<b>Quite Likely 4</b>	<b>Extremely Likely 5</b>

**If you were to major in a math or science-related field, how likely would you be to...**

30. Have too many other demands on your time to allow the study time required for this field	1	2	3	4	5
31. Have poor-quality teachers in your math and science-related courses	1	2	3	4	5
32. Feel that you are different from other in this major because of your gender	1	2	3	4	5
33. Have too little money to afford things (like computer software or tutoring) that you might need to do well in your coursework	1	2	3	4	5
34. Be concerned about the amount of competition among students in this field	1	2	3	4	5
35. Feel that your education/career options are limited by financial concerns	1	2	3	4	5
36. Feel pressure from parents or other important people to change your major to some other field	1	2	3	4	5

APPENDIX E

COPING WITH BARRIERS SCALE

Luzzo & McWhirter (2001)



8. Money problems...	1	2	3	4	5
9. Family problems...	1	2	3	4	5
10. Not being smart enough...	1	2	3	4	5
11. Negative family attitudes about college...	1	2	3	4	5
12. Not fitting in at college...	1	2	3	4	5
13. Lack of support from teachers...	1	2	3	4	5
14. Not being prepared enough...	1	2	3	4	5
15. Not knowing how to study well...	1	2	3	4	5
16. Not having enough confidence...	1	2	3	4	5
17. Lack of support from friends...	1	2	3	4	5
18. My gender...	1	2	3	4	5
19. People's attitudes about my gender...	1	2	3	4	5
20. My ethnic background...	1	2	3	4	5
21. People's attitudes about my ethnic background...	1	2	3	4	5
22. Childcare concerns...	1	2	3	4	5
23. Lack of support from my "significant other"...	1	2	3	4	5
24. My desire to have children...	1	2	3	4	5
25. Relationship concerns...	1	2	3	4	5
26. Having to work while I go to school...	1	2	3	4	5
27. Lack of role models or mentors...	1	2	3	4	5
28. Lack of financial support...	1	2	3	4	5

APPENDIX F

MATH/SCIENCE SELF-EFFICACY SCALE

Smith and Fouad (1999)

**Instructions:** Please indicate the degree to which you agree or disagree that you could do each statement below **by circling the appropriate number to the right of each statement.**

	Very Strongly Disagree 1	Mostly Disagree 2	Slightly Disagree 3	Slightly Agree 4	Mostly Agree 5	Very Strongly Agree 6
<b><u>I feel confident that with the proper training I could:</u></b>						
1. Earn an A in a math course:	1	2	3	4	5	6
2. Predict the weather from weather maps:	1	2	3	4	5	6
3. Earn an A in a science course:	1	2	3	4	5	6
4. Figure out how long it will take to travel from Green Bay to Detroit, driving 55 mph:	1	2	3	4	5	6
5. Design and describe a science experiment that I want to do:	1	2	3	4	5	6
6. Classify animals that I observe:	1	2	3	4	5	6

APPENDIX G

MATH/SCIENCE OUTCOME EXPECTATIONS SCALE

Smith and Fouad (1999)

**Instructions:** Please indicate the degree to which you agree or disagree with the statement below by circling the appropriate number to the right of each statement.

	Very Strongly Disagree 1	Mostly Disagree 2	Slightly Disagree 3	Slightly Agree 4	Mostly Agree 5	Very Strongly Agree 6
1. If I get good grades in science, then my friends will approve of me:	1	2	3	4	5	6
2. If I get good grades in math, then my parents will be pleased:	1	2	3	4	5	6
3. If I take a lot of math classes, then I will be better able to achieve my future goals:	1	2	3	4	5	6
4. If I do well in science courses, then I will be better prepared for the work world:	1	2	3	4	5	6
5. If I learn math well, then I will be able to do lots of different types of careers:	1	2	3	4	5	6
6. If I take a math course, then I will increase my grade point average:	1	2	3	4	5	6
7. If I do well in science classes, then I will do better in life:	1	2	3	4	5	6
8. If I get good grades in science, then my parents will be pleased:	1	2	3	4	5	6
9. If I get good grades in math, then my friends will approve of me:	1	2	3	4	5	6



APPENDIX H  
MATH/SCIENCE INTEREST SCALE  
Smith and Fouad (1999)

**Instructions:** Please indicate the degree to which you agree or disagree that you would like to do each of the activities listed below **by circling the appropriate number to the right of each statement.**

	Very Strongly Disagree 1	Mostly Disagree 2	Slightly Disagree 3	Slightly Agree 4	Mostly Agree 5	Very Strongly Agree 6
1. Taking classes in science:	1	2	3	4	5	6
2. Visiting a science museum:	1	2	3	4	5	6
3. Listening to a famous scientist talk:	1	2	3	4	5	6
4. Solving computer problems:	1	2	3	4	5	6
5. Solving math problems:	1	2	3	4	5	6
6. Creating new technology:	1	2	3	4	5	6
7. Touring a science lab:	1	2	3	4	5	6
8. Joining a science club:	1	2	3	4	5	6
9. Reading about science discoveries:	1	2	3	4	5	6
10. Participating in a science fair:	1	2	3	4	5	6
11. Working with plants and animals:	1	2	3	4	5	6
12. Working in a science laboratory:	1	2	3	4	5	6
13. Learning about energy and electricity:	1	2	3	4	5	6
14. Taking math classes:	1	2	3	4	5	6
15. Inventing:	1	2	3	4	5	6
16. Watching a science program on TV:	1	2	3	4	5	6
17. Using a calculator:	1	2	3	4	5	6

APPENDIX I  
INTENTIONS-GOALS SCALE  
Smith and Fouad (1999)

**Instructions:** Please indicate the degree to which you agree or disagree with the statement below by circling the appropriate number to the right of each statement.

	Very Strongly Disagree 1	Mostly Disagree 2	Slightly Disagree 3	Slightly Agree 4	Mostly Agree 5	Very Strongly Agree 6
1. I am committed to study hard in my math courses:	1	2	3	4	5	6
2. I plan to take more science classes in college than will be required of me:	1	2	3	4	5	6
3. I plan to take more math classes in college than will be required of me:	1	2	3	4	5	6
4. I intend to enter a career that will use math:	1	2	3	4	5	6
5. I am committed to study hard in my science courses:	1	2	3	4	5	6
6. I am determined to use my science knowledge in my future career:	1	2	3	4	5	6
7. I intend to enter a career that will use science:	1	2	3	4	5	6

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## VITA

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